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AN OBJECTIVE METHOD FOR THE ADMINISTRATION OF X-RAYS

by

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It is well known that even experienced radiologists get from time to time wholly unexpected results following X-ray treatments. Such »anomalous» results emphasize the fact that, at best, the radiologist possesses insufficient data on which to base his expectations. The factors to be considered are very numerous and complex. Many are little known, or completely unknown and even unsuspected. Therefore it is not surprising if predictions do not always come true. While we may never be in a position to know and control *all* the factors involved in the treatment of cancer by radiation, it is very desirable, obviously, to strive towards the ideal goal. The variables which may be investigated with the least difficulty are those of a physical nature, and they are the ones considered in this paper. It is evident that when we are reasonably sure of the physical conditions of our treatments, we are in a much better position to obtain the proper correlation between dose and resultant effect.

In a previous publication[1] from this laboratory, we gave the data necessary to calculate with sufficient accuracy the dose of radiation at different tissue depths for any practical conditions of target-skin distance, size of field, and thickness of copper filter, provided an ordinary machine with a mechanical rectifier is used and the tube voltage is 200 K. V. (crest). The doses which can be calculated by means of the equation given there, are those along the central ray of the beam of radiation. By making use of a special photographic method in conjunction with the results of ionization

[1] The Economics of Dosimetry in Radiotherapy, FAILLA and QUIMBY, Amer. Jour. Roentgenology, X, 12, 944, 1923.

experiments, we then made a large number of diagrams similar to the DESSAUER charts, showing the distribution of radiation in a water phantom within and outside of the geometrical beam. With these diagrams we could determine the conditions of treatment to deliver the desired dose to the patient. This sort of work has been done for some time in other clinics, especially in Europe, and we simply adopted an eclectic method.

Now it is one thing to map out a treatment on paper, and an entirely different thing to make sure that the patient receives the doses as planned. If we cannot be reasonably sure that the treatments given correspond with those decided upon, then it is a waste of time to use elaborate charts and methods of dosage. With this thought in mind we made a careful analysis of the problem, and deduced the essential requirements. We then developed the necessary apparatus for practical use. In describing this apparatus we shall follow the order in which it is used in practice.

I. Localization of the Region to be Treated and Determination of Fields

In treating deep-seated tumors, the thickness of tissue to be traversed by the rays has a very marked influence on the amount of radiation reaching the diseased region. A glance at the typical distribution chart of Figure 1 will show this very clearly. It is of great importance, therefore, to determine the position of the tumor within the body as accurately as possible. In most cases, however, direct measurements cannot be made, and in the ultimate analysis the location of the tumor depends largely on the judgement of the clinician. This is especially true, since no one can be certain just how far a tumor may have extended beyond the obviously involved region. The clinician, however, should make use of every available means to help him in this difficult task.

It is evident that a knowledge of the relative positions of the organs in the neighbourhood of the tumor will facilitate matters considerably. Anatomical cross-sections are useful in this connection. However, one finds almost invariably that the cross-section of a patient at the tumor level differs in size and shape from the standard section in books on anatomy. Accordingly, the latter cannot be used directly for dosage purposes. The standard anatomical chart may differ by one centimeter or more from the patient's contour at the port of entry of the rays. A difference of one centimeter in the tissue depth will cause a difference of about 20 percent in the tumor dose, depending on the tissue depth. Thus, referring to Figure 1, we find that the dose at 10 cm. depth is 33 percent,

and at 9 cm. it is 38 percent. The difference between the two is 5 units, or 18 percent. Without going into further details we may conclude that the actual contour drawing of the patient at the tumor level should be used for the determination of depth doses or for mapping out treatments. Furthermore, it is important to locate the position of the tumor on this contour chart as accurately as possible, for evidently a difference of one centimeter in the tissue depth here will also result in a difference of about 20 percent in the tumor dose.

We thought that the accuracy with which this can be done would be increased materially if we had anatomical sections which could be magnified or reduced in size to suit the particular case under consideration. An obvious method to bring this about is to project the sections on the screen by means of a lantern. By varying the distance between the lantern and the screen any desired size can be obtained. We made a convenient device for this purpose (Figure 2), in which the lamp house and the lens can be moved independently by turning two knobs placed near the screen. A piece of ground glass makes a very good screen, especially since it permits the use of the lantern in daylight.

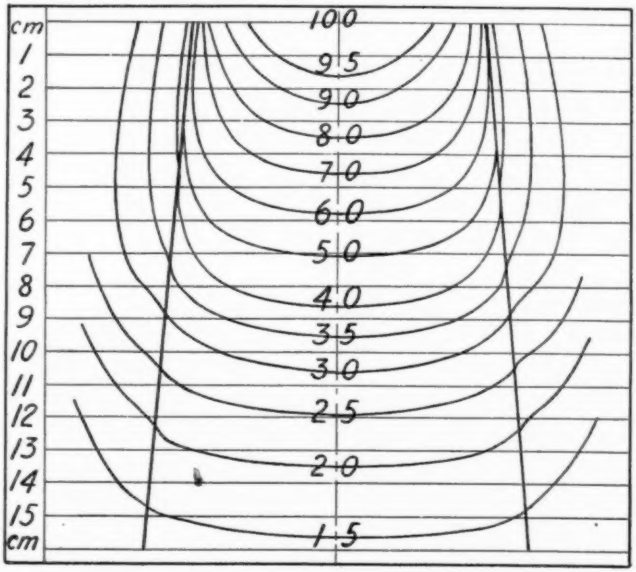


Fig. 1.

Voltage 200 K. V. (crest) mechanically rectified. Water phantom 30 × 35 × 30 cm.[3]

T—S distance 50 cm. Field area 100 cm.[2] Filter 0.5 mm. Cu.

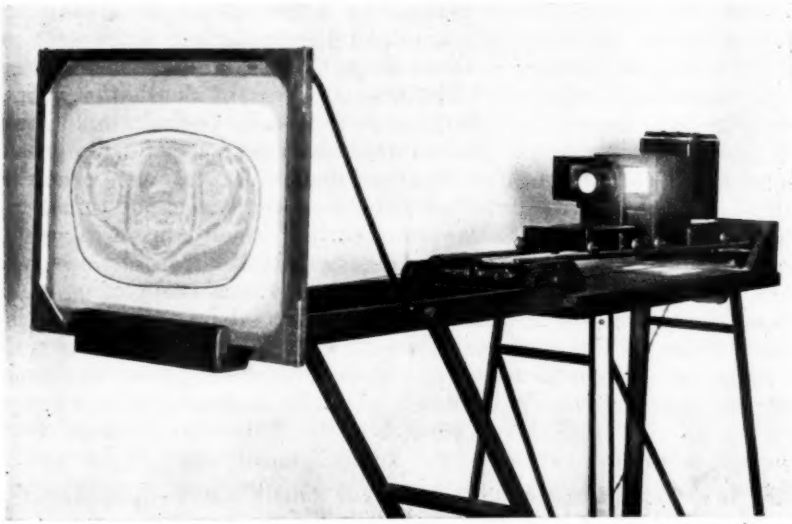


Fig. 2.

The patient's contour at the tumor level (Figure 3) is reproduced very carefully on transparent paper, which is then attached to the ground glass screen. Having selected the slide for the corresponding level, it is projected on the screen, and the size of the image is adjusted so as to coincide as nearly as possible with the patient's contour. Since in general the two are not of the same shape, exact coincidence cannot be obtained, and it is for the clinician who has

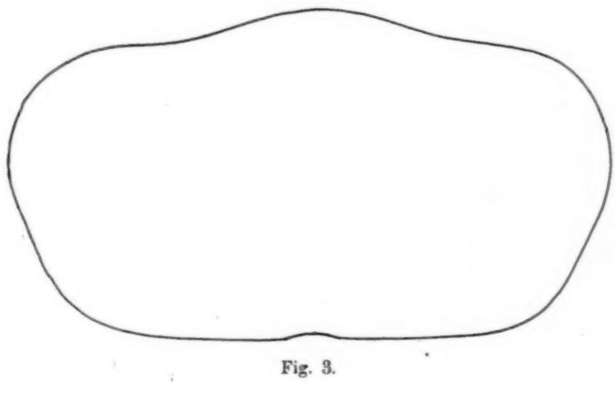


Fig. 3.

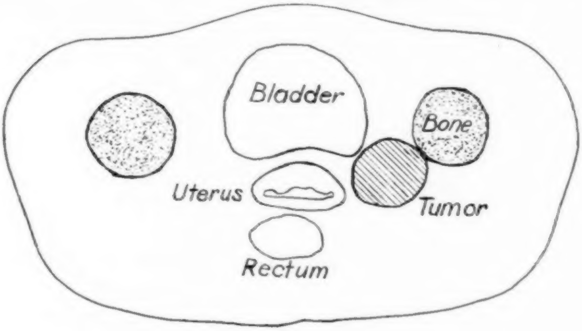


Fig. 4.

examined the case to decide what is the closest superposition. The clinician determines also the location and extent of the tumor and marks it on the chart. In doing this he makes use of all available information based on a careful examination of the patient, actual measurements, and his general experience. If it is thought desirable to limit the dose of radiation reaching certain normal organs, they are outlined on the chart with a red pencil. Figure 4 shows the contour chart of Figure 3 after the tumor and important organs have been located on it.

We are now ready to determine the treatments to be given. The contour chart is removed from the screen, and is placed on a table, (Figure 5) with a ground-glass top which is illuminated from below. By placing distribution charts of the type shown in Figure 1 under the contour chart, one gets an idea of the tumor dose obtainable

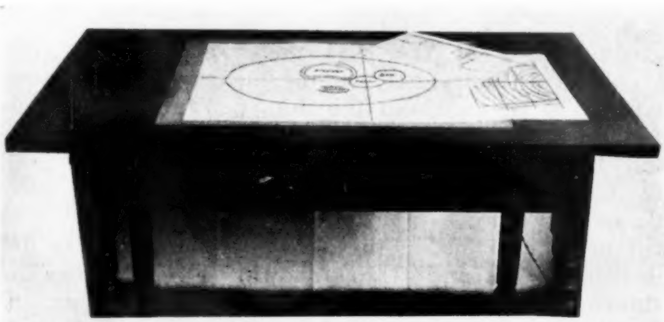


Fig. 5.

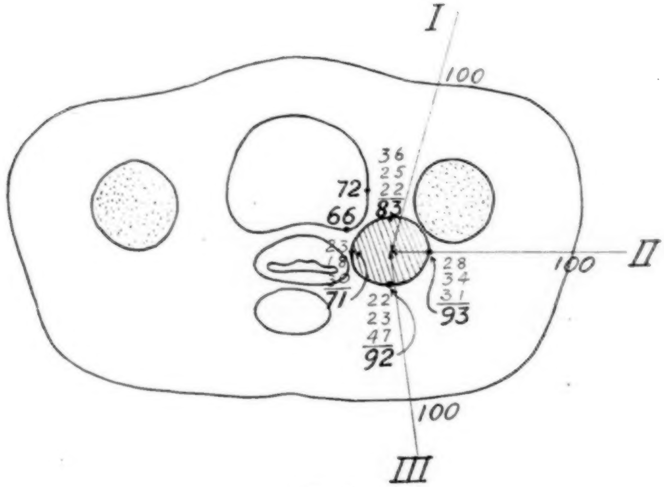


Fig. 6.

I and III: T—S distance 50 cm.
Field 50 cm.[2]
Filter 0.5 mm. Cu.

II: T—S distance 50 cm.
Field 100 cm.[2]
Filter 0.5 mm. Cu.

from one treatment. The question of what dose should be given the tumor and what the surrounding normal tissues can tolerate, is discussed by the radiologist, the clinician in charge of the case, and the pathologist (if available). The physicist has nothing to do with this phase of the problem, nor, indeed, with the localization of the tumor. He is simply called upon to indicate the possibilities of irradiation in different directions, singly or combined, and to outline the distribution of radiation which would result. After a number of trials, a certain treatment plan is adopted in accordance with the clinical requirements of the case under consideration, compatible with the physical limitations of the means at our disposal. The different fields to be used and the data pertaining to the treatments are then put on the contour chart for permanent record. The doses from each treatment and the combined doses for representative points in the tumor and surrounding tissues are also recorded on the chart, as in Figure 6.

It will be noted, that in this particular case, it was decided to use three fields, I, II, and III, as shown. For all three the target-skin distance is 50 cm., and the filter, 0.5 mm. copper. The field areas, however, are 50, 100, and 50 sq. cm. respectively. The relative depth doses corresponding to each field are given for the four

points indicated on the periphery of the tumor, in the order in which the fields are numbered. The total relative dose for each point is the sum of the three, as shown in heavier type. The totals are also given for two points on the side of the bladder closest to the tumor area. The positions and sizes of the fields in this case were governed largely by the desire to avoid intense irradiation of the bladder and rectum. As a result the distribution of radiation within the tumor area is not very uniform. Since, however, cases of this type receive also radium radiation through the vagina, the deficiency in the X-ray doses on this side of the tumor is not important.

It might be well to mention here that in attempting to correlate the doses of radiation delivered to any point in the patient's body with the effects produced, it is of the utmost importance to consider the time element involved in the treatments. The expectation of similarity in effects is not justified unless *all* the dosage factors are the same, and the quantity of radiation is only one of these.[1] Nor can we expect identical results if the biological factors are different.

II. Administration of Treatments

Having traced the patient's contour on paper, and having decided upon the number of fields and their relative positions, it is necessary to consider the question of administering the desired treatments.

The chief desideratum is how to adjust the *relative* position of the patient and the tube for each treatment to make sure that the center of the beam of radiation passes through the center of the tumor, or any given point. It is necessary also to fix all other conditions to insure the same distribution of radiation within the patient as was determined on the chart. According to the dictates of experimental science, the precision of administration of a treatment cannot be very great unless objective methods are used for setting up the patient. If subjective methods predominate, as is usually the case, then everything depends on the judgement of the person who is setting up the patient, which may vary considerably. In the ordinary X-ray technique the pointing of the beam of radiation in the proper direction is done almost entirely by eye. With target-skin distances of 70 cm., or even 50 cm., it is by no means a simple

[1] A Brief Analysis of Some Important Factors in Biological Action of Radiation, Am. Jour. Roentgenology, Nov., 1924.

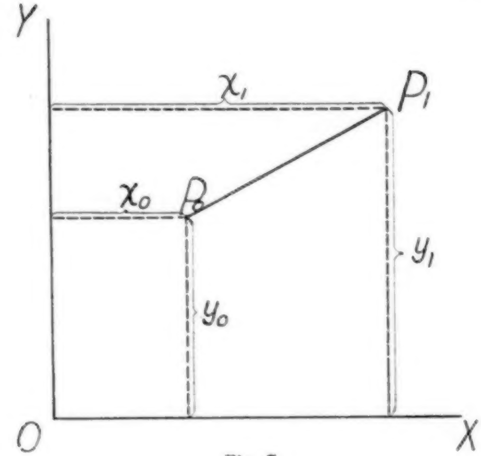


Fig. 7.

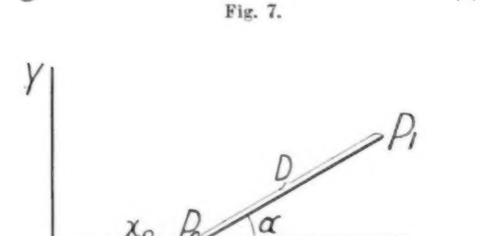


Fig. 8.

matter to do this accurately for oblique positions of the beam. In view of these considerations, we decided to develop an objective method for doing this.

1. Geometrical Considerations. Let us consider the problem from the geometrical point of view. We take the center of the tumor as one point, and the focal spot of the target as another. These two points must be a given distance apart. The line joining them must be in a certain definite position *with respect to the patient.* How can we bring this about? Let us take a simple case first.

In plane analytical geometry it is customary to take two lines at right angles to each other as a system of reference. Any point in their plane can then be definitely located by stating how far the point is from each line. Thus, in Figure 7 the location of the point P_0 is known if the distances x_0 and y_0 are given. Similarly, the distances x_1 and y_1 determine the position of point P_1. The four coordinates, x_0, y_0, x_1, y_1, determine the position and length of the line P_0P_1. In solid geometry the system of reference may be composed of three planes mutually at right angles. A point is located by giving the perpendicular distances from each of the three planes; a line by six coordinates.

There are other ways in which a line can be defined. Thus, in Figure 8, knowing x_0, y_0, the angle α, and the distance D, we have located the line P_0P_1 in the plane XOY. Similarly, we could use

several other combinations of distances and angles to accomplish the same result. However, it is very important to remember that, no matter what combination we choose, four independent coordinates are necessary to define a line in a plane. All the coordinates may not be given explicitly, but they must always be given in some way. For instance, if we choose our »reference lines so that they intersect at the point P_0» (see Figure 9), the line P_0P_1 is determined by the distances x_1 and y_1. Apparently only two coordinates are needed in this case, but in effect the statement in quotation-marks above implies the other two: $x_0 = 0$, and $y_0 = 0$. To locate a line in space six independent coordinates are necessary, some of which may be angles, as shown above for the case of plane geometry (and some of which may be zero). From this brief discussion, it is evident that the line joining the center of the tumor and the focal spot of the X-ray tube can be definitely located in the treatment room by giving *six coordinates* with respect to two mutually perpendicular walls and the floor as reference planes.

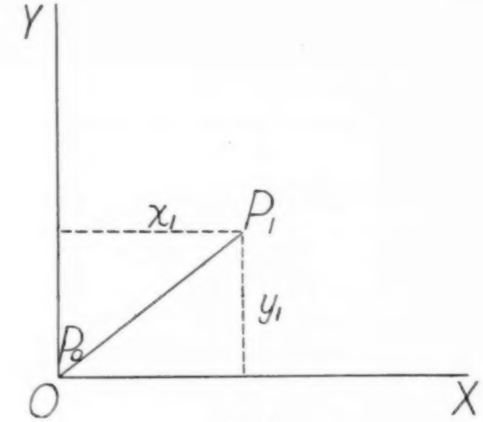


Fig. 9.

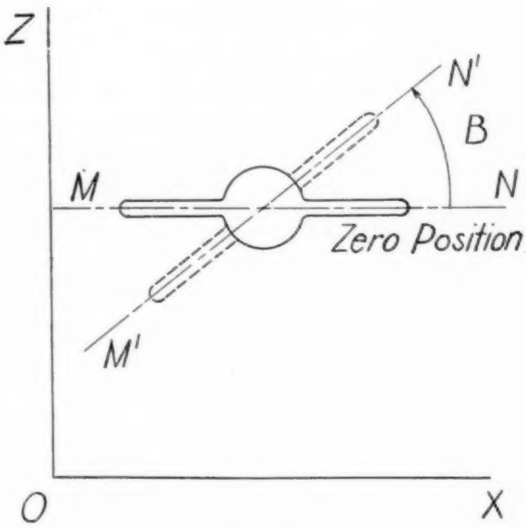


Fig. 10.

The next point to consider is the question of rotation. It is

clear that fixing the center of the tumor and the focal spot with respect to the room, does not determine the positions of the patient as a whole, or the tube as a whole. Each can be rotated in many different ways, while still maintaining the line between tumor and target in a fixed position. In order to control the angular positions of the two, it is necessary to establish first reference axes in each.

For the patient:

Longitudinal axis, — line running from head to feet.

Lateral axis, — line parallel to extended arms.

Frontal axis, — line perpendicular to the above two.

Origin, (Point of intersection of the three) — center of tumor.

For the Coolidge tube:

Longitudinal axis, — line running from terminal to terminal.

Lateral axis, — line perpendicular to the above and parallel to the surface of the target.

Frontal axis, — line perpendicular to the above two. (The beam of radiation ordinarily employed is parallel to this axis.)

Origin (Point of intersection of the three) — center of focal spot of target.

If we assume the axes to be in their zero positions when they are respectively parallel to the three reference axes X, Y, Z, of the room, we can indicate any subsequent position by giving the angles α, β, γ, and A, B, C, for the patient and the tube respectively. To make this clear we shall consider a simple case in one plane. In Figure 10 the Coolidge tube with its longitudinal axis parallel to the OX axis and its lateral axis parallel to the OY axis (not shown), is in its zero position. If it is turned counter-clockwise to the position indicated by the dotted lines, the new location can be designated by stating the magnitude of the angle B. The same holds true for rotation around any other tube axis. In the general case, where the tube is rotated about each of its three axes, its final position can be defined by three angles, A, B, C, in an analogous way.

Similarly, the position of the patient can be designated by three other angles, α, β, γ. In this case, however, practical considerations limit the number of ways in which the patient can be turned. But since the tube, if properly supported, can be made to assume any desired position with respect to the patient, no limitation as to position in the administration of treatments need exist.

The preceding discussion shows how it is possible to designate the position of the center of the tumor and the focal spot of the target, by using the floor and two adjacent walls of the treatment room as a system of reference. To do this, six coordinates must be given. We have shown also that the angular positions of the

patient and tube can be defined by six angles. Accordingly, in order to specify the exact location of the two in the treatment room, we need twelve independent quantities. We shall see later that, in practice, this number can be greatly reduced by assigning permanent values to some.

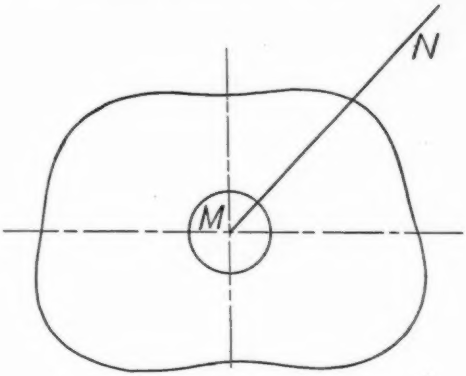


Fig. 11.

2. Determination of Coordinates. The next question to consider is how to determine the values of the coordinates corresponding to the treatment we wish to administer. On the patient's contour chart we mark the position of the fields and the data pertaining thereto, according to the method described in the first part of the paper. Figure 11 shows one such contour chart, details not pertinent to this discussion being omitted. The axis of the beam of radiation is to be along the line *MN*. In order to refer this line to a system of coordinates, it is necessary in the first place to locate the reference lines on the diagram. In this particular case they will be the frontal and the lateral axes of the patient. Their directions can be located by folding the paper so as to divide the section into four equal quadrants, as nearly as possible. The dotted lines in Figure 11 represent the creases in the paper. The reference axes are then drawn parallel to these, and passing through the center of the tumor. They are shown in Figure 12 as *OX* and *OY*. We can determine now the inclination of the line *MN* by measuring the angle *B* which it makes with the *Y* axis.

If the central ray of the beam of radiation is to be along the line *MN*, then the focal spot of the target must be on the prolongation of this line. And for a target-skin distance of 50 cm., it must be 50 cm. from the skin. Since, however, in general, the skin surface is not perpendicular to the line *MN*, and the target-skin distance should be measured from the point on the skin within the field which is nearest to the target, we draw the line *PQ* perpendicular to *MN*, passing through this point *L* on the contour. We then measure 50 cm. from this line along *MN* and locate the position of the focal spot at *F*. We can designate the position of *F* relative to the patient by giving the distances x and y, as shown. By

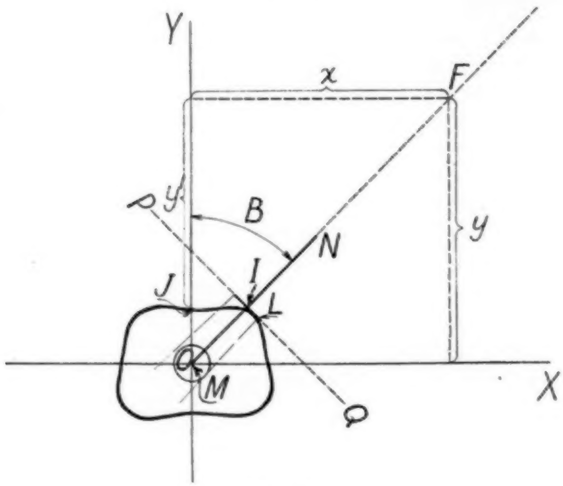


Fig. 12.

reproducing these distances and the angle *B* in the treatment room, we can set up the patient and the tube in the proper relation to each other to give the desired treatment.

Before describing how this can be done, in practice in a simple way, we shall explain two methods for determining the coordinates *x*, *y*, and *B*. We may call the first the full scale method and the second the trigonometric one. In developing the former we attempted to make it as nearly mechanical as possible. We built a big drawing board (Figures 13 and 14) to which the patient's contour chart can be attached with thumb tacks in the proper relation to the axes *X* and *Y*. To determine the angle *B* the board is provided with a graduated quadrant. A long arm is pivoted at the center of the tumor and is rotated until it coincides in direction with the line *MN*. The angle which this makes with the *y* axis is then read directly on the quadrant (see Figure 13). The same arm is provided with a sliding T-square whose cross-piece can be set at the point on the skin contour from which the target-skin distance is to be measured. The T-square is graduated in centimeters so that the desired target-skin distance can be read directly. The point corresponding to the focal spot is marked on the board by sticking a pin into it. To determine the distance *x* we provided an arm with a scale in centimeters which can be moved up and down always parallel to the *x* axis. By bringing this up to the pin, we can read the distance *x*

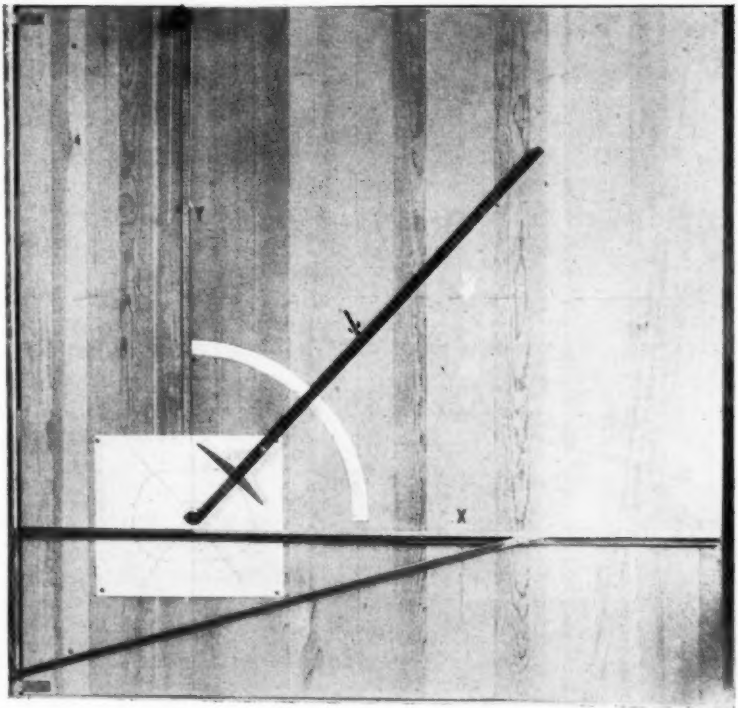


Fig. 13.

on the scale. (See Figure 14.) To determine the distance y one could have a fixed centimeter scale on the board reading zero at the point O. As we shall see later, however, it is more convenient to use the distance y' as one of the coordinates.[1] To measure this distance we have another sliding scale which can be set with its zero on the point J (Figure 12) in the patient's contour, directly above the center of the tumor. This scale is read at the time that the distance x is read.

While this method is simple, convenient, and direct, it necessitates the use of the special board here described. The trigonometric method, however, requires only an instrument for measuring angles, — a simple goniometer. Tables have been worked out in trigonometry which enable us to calculate the lengths of two sides when the

[1] For simplicity we shall call this the y coordinate from now on.

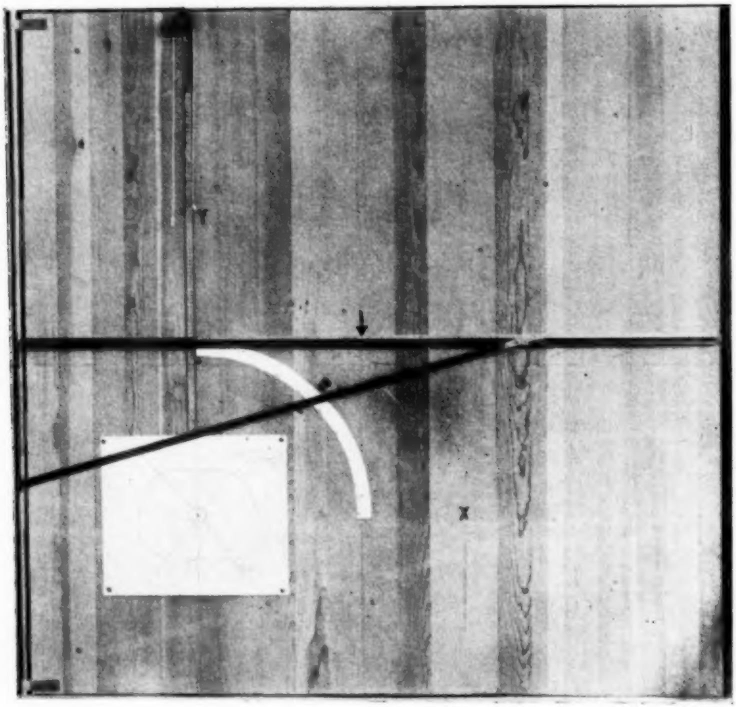


Fig. 14.

length of the third side and the magnitude of one of the acute angles in a right-angled triangle are given. In Figure 12, OYF is a right-angled triangle. The angle B can be measured on the contour chart. The distance OI can be measured with a centimeter scale, and this plus the required target-skin distance gives us the length OF. Then from trigonometry we have

$$x = YF = OF \text{ sine } B$$
$$y = OY = OF \text{ cosine } B$$

Since the values of sine $= B$ and cosine $= B$ for any desired value of B can be found in mathematical tables, we can calculate x and y. To determine the value of y' we have $y' = y - OJ$, and OJ can be measured directly on the contour chart. For reasons which we need not give here, the trigonometric method is more accurate than the

full scale method. It requires no special apparatus and is very simple.

It will be noted that apparently we need only three[1] coordinates, x, y, and B, to define the relative positions of the tube and the patient for each treatment. However, this is due to the fact that we have made some tacit assumptions. Thus we have reduced the problem to one in plane, instead of solid geometry, by assuming that the central ray of the beam of radiation is in the plane of the contour chart, and that it can be rotated in this plane. Since this can always be brought about in practice, the procedure is satisfactory. A further simplification results from choosing the center of the tumor as the origin of coordinates. Since, however, it is not possible to measure distances directly from the center of the tumor, it is necessary to resort to indirect methods. These will be apparent presently, as we describe the procedure for setting up the patient and the tube in the treatment room.

3. Method for Setting up the Patient

A. *General considerations.* It will be seen that the essential requirement here is that the patient and the tube shall be placed in a definite *relative* position. To bring this about we can keep the patient in a fixed position and move the tube; we can maintain the tube stationary and move the patient; or we can move the two and coordinate the movements so as to avoid duplication. The third alternative is probably the most convenient in practice. But after having adopted this method, we have still to determine which motions shall be assigned to the tube and which to the patient. In making this choice a great deal depends on the majority of cases to be treated, and on the personal opinion of the radiologist. The scheme we adopted is the one we thought would combine the maximum simplicity of construction and operation with the necessary flexibility. The question of construction had a considerable influence on our decision, inasmuch as the apparatus was made in our laboratory. What we wish to emphasize in this paper, however, is not the particular apparatus developed, but the procedure employed to bring the patient and the tube into the proper relative positions.

For the general case we must have three motions of translation and three motions of rotation. We decided to assign only one motion of translation to the patient — that along his longitudinal axis

[1] The number could even be reduced to two.

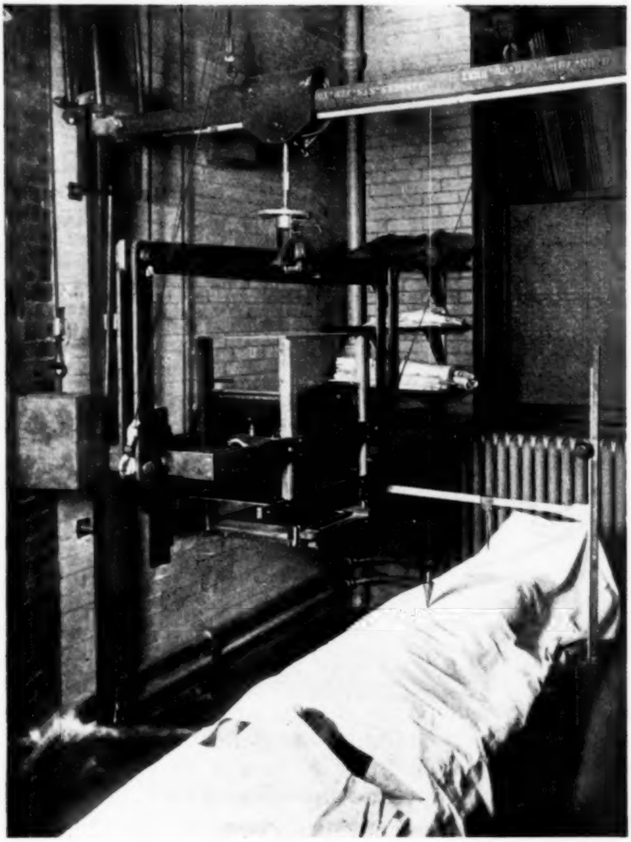


Fig. 15.

when lying down. We then arbitrarily stipulated that the motion of rotation of the patient should be only through 90 degrees or 180 degrees. That is, the patient could be placed on the treatment table with his *head* toward the door (for example) or his *feet* toward the door, the second position corresponding to a rotation of 180 degrees from the first one. He could lie prone, or on his back, or on his right side, or on his left side, but he could not assume any intermediate position. This restriction was made simply for the comfort of the patient. The tube was assigned two motions of translation at right angles to each other and to the longitudinal axis of

Fig. 15 A.

the patient. No important limitations were imposed on its motions of rotation.

B. *Equipment of the Treatment Room.* The actual apparatus is shown in Figures 15 and 15 A. The treatment table is 220 cm. long, 62 cm. wide, and 50 cm. high. It has wheels running on tracks on the floor so that it can be moved lengthwise parallel to one wall of the room. This provides for the motion of translation already mentioned. To supply the other two linear motions at right angles to this, the tube holder is capable of movement up and down, and horizontally. For this purpose a steel tube *T* (Figure 16) 5 cm. square is supported vertically against the wall, and another square tube *T'* is held horizontally by means of the carriage *C*, which

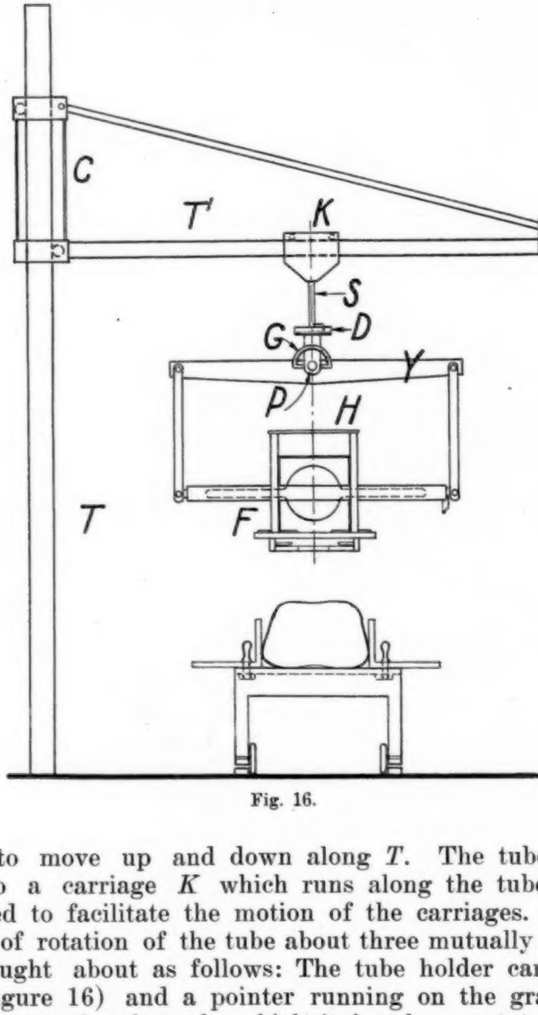


Fig. 16.

allows it to move up and down along T. The tube holder H is attached to a carriage K which runs along the tube T'. Rollers are provided to facilitate the motion of the carriages.

Motion of rotation of the tube about three mutually perpendicular axes is brought about as follows: The tube holder can turn on the shaft S (Figure 16) and a pointer running on the graduated drum D reads the angle through which it has been rotated. The yoke Y is pivoted at P and is linked loosely to the frame F to which the Coolidge tube is attached. With this arrangement any angular motion of the yoke is reproduced by the frame F, and therefore by the tube.[1] If the focal spot is directly under the pivot P when the

[1] The author saw this link arrangement in operation in France.

tube is in the horizontal position, it will remain stationary when the yoke is turned through a given angle. This is shown by the dotted lines in Figure 17. A graduated scale *G* and a pointer are provided to read the angle through which the tube has been rotated. To supply the third angular motion, the frame *F* is pivoted at the ends so that it can turn about its longitudinal axis. A graduated scale is also provided here. (See Figure 18.) It is very important to note that in this tube holder the three axes of rotation pass through the focal spot of the target, and that therefore its position remains undisturbed when the orientation is changed in any direction. Thus distances and each angle can be set up independently. A schematic drawing with essential dimensions is given in Figure 19.

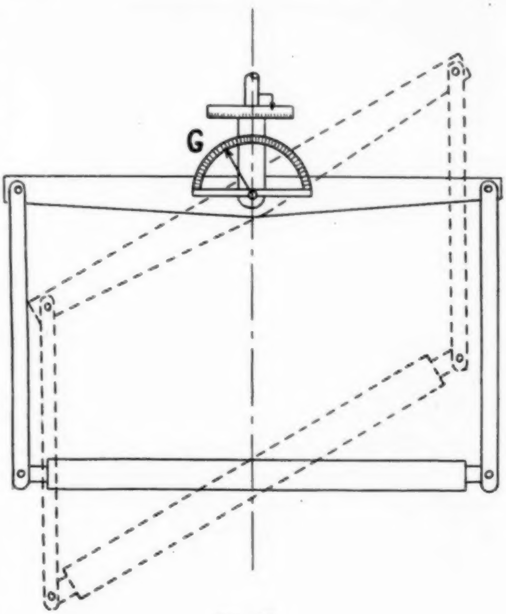


Fig. 17.

The tube holder is provided with a diaphragm placed at a distance of 28 cm. from the target, making it possible to give treatments with a 30 cm. target-skin distance. A simple mechanism consisting of racks and pinions enables us to vary the size of the diaphragm from 0 to 18 cm. in either direction independently, by turning a knob. Since each turn corresponds to a movement of 4 cm. in the lead plates, the knobs are graduated, and the size of the aperture can be read on them. We have calculated the diaphragm sizes corresponding to different sizes of field at different target-skin distances, in order to facilitate the work still further. This makes it possible to obtain the desired area for the port of entry without using a fluorescent screen or measuring the skin illuminated by the light reflected from the target. Space is provided above the diaphragm for an ionization chamber in order to measure the radiation emitted in the direction of the beam to be utilized. When using the ionization chamber, the filter is placed thereon, so

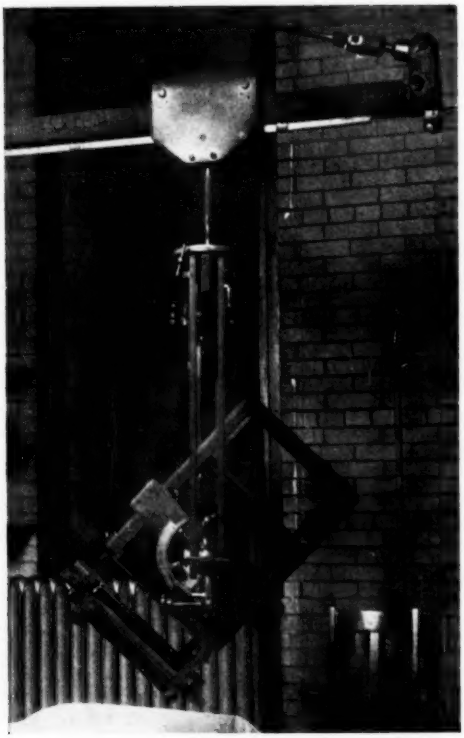


Fig. 18.

that the measurement is made of the radiation which then goes to the patient. A suitable housing made of thick lead glass and placed around the central portion of the tube affords sufficient protection to the patient from radiation other than the desired beam. Sheet lead is also used in some parts for the same purpose. The tube holder is carefully balanced so that when oriented in any direction it will remain at rest. Nevertheless means are provided to prevent accidental shift. The use of worm gears brings this about and at the same time provides a convenient means for setting the tube holder at the desired angles. A rack and pinion arrangement facilitates the motion of the carriage *K* on the horizontal beam *T′*. A system of pulleys, counterweights, and gears makes possible the raising with little force of the tube and its supporting parts, which are quite heavy.

In order to economize space and at the same time provide for the treatment of any part of the body in any direction, the horizontal beam supporting the tube holder must be suitably situated in the treatment room. The lay-outs shown in Figures 20, 21 and 22 fulfil the necessary requirements. The arrangement of Figure 20 requires the least floor space, but it is not so convenient as the other two. For some treatments the table must be placed on the other side of the room, and therefore two sets of tracks must be provided. In Figure 21 the tube is always on the same side of the table. Treatments on either side of the patient may be given by placing him with his feet pointing towards one end or the other of the room, and rolling the table on the tracks to the proper place. In Figure 22 the tube may be on either side of the table, depend-

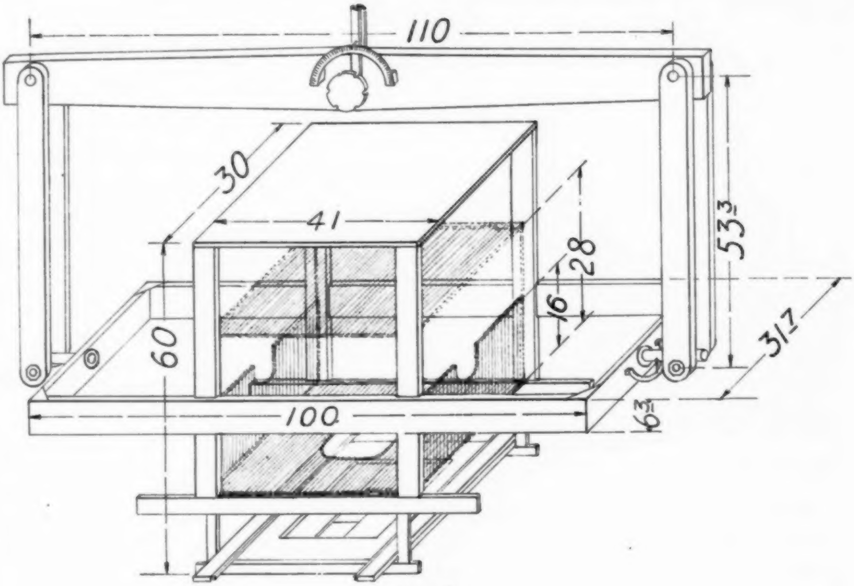


Fig. 19.

ing on the patient's side to be treated. With any one of the three plans shown it is possible to use a target-skin distance of 70 cm. for any conceivable treatment, without having either tube terminal too close to the wall. Smaller rooms, of course, may be used if one is willing to accept the consequent limitations or inconveniences. It should be noted, however, that in any case the design of the tube holder influences the size of the room.

It may be well to say a few words about the construction of tube holders. There are three main factors which influence their design: (1) Protection of patient from electric shock, (2) Protection of operator and patient from X-radiation, (3) Flexibility. Complete and certain electric protection of the patient is best obtained by interposing between the tube as a whole and the patient a metallic surface which is *permanently* grounded. An enclosed tube holder, of the type extensively used in the United States, fulfils this requirement and at the same time affords almost complete protection from X-rays if the lead lining is sufficiently thick. On account of the radiation scattered by the patient's body, however, additional lead protection must be provided for the operator. Tube holders of this type, unfortunately, are very large, so that the flexibility of opera-

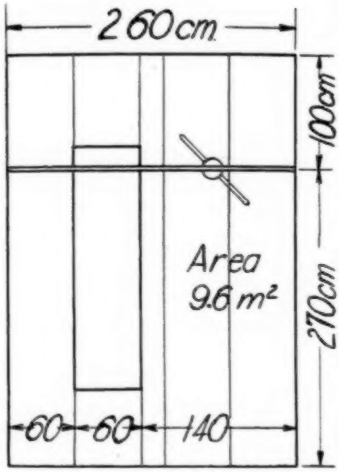


Fig. 2 .

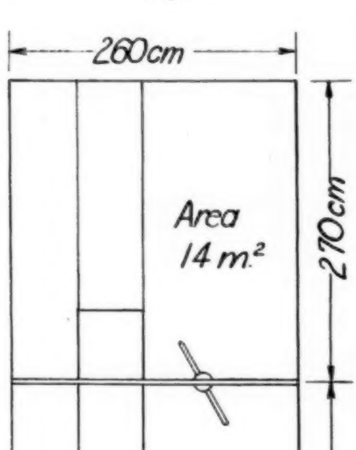


Fig. 21.

tion is rather limited. It may be possible to reduce their size by the proper use of insulating materials between the tube and the grounded shield, but no such holder is available at present. The one we constructed affords considerable protection from the X-rays, but the high voltage terminals are exposed. On account of the great flexibility of the holder, however, in the large majority of treatments, the tube terminals can be placed at a sufficient distance from the patient. For special treatments we have provided a sheet of wire mail 1 × 1.5 m. which can be laid over the patient like a blanket, and grounded. Any discharge to the mail due to a surge in the high voltage line is carried to earth without reaching the patient. At the center of the sheet a section 20 × 20 cm. may be replaced by a piece of aluminium 0.5 mm. thick, to be placed over the region to be treated. The use of the wire mail is illustrated in Figure 23.

C. *Practical Procedure.* Let us take as an example the treatment of a case of cancer of the œsophagus. The complete contour chart for the patient is shown in Figure 24. To give treatment number I we have to reproduce, with the above apparatus, the corresponding settings of x, y, and B recorded on the chart. Since the center of the tumor is to be taken as the reference point, it is necessary in the first place to set this point in the proper relation to the measuring scales. One of these is provided on the vertical steel tube, and one on the horizontal beam. The patient is placed on the table in a horizontal position

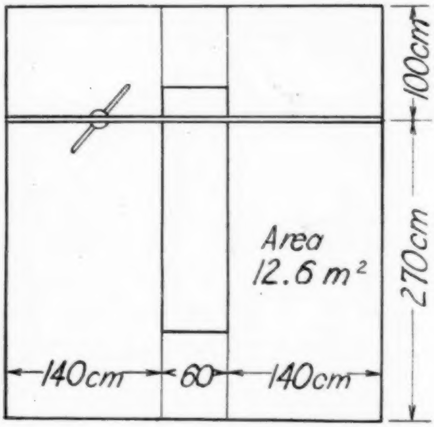


Fig. 22.

as nearly as possible. By moving the table on the tracks, the body level corresponding to the contour on the chart can be brought in the plane of the vertical and horizontal iron beams, (the X and Y axes respectively). To bring the center of the tumor to the zero level of the vertical scale, we could raise or lower the table. Similarly, to bring the same point to the zero of the horizontal scale, we could move the table sideways. It is much more convenient, however, to move the scales themselves to the proper positions. For this reason they are not rigidly attached to the iron beams, but are arranged to slide along them. A rack and pinion mechanism in each facilitates the manipulation.

To set the horizontal scale a plumb bob is suspended from the zero point on the scale. The latter is then moved until the bob is directly over the center of the tumor, barely touching point *J*, which is marked on the patient for this purpose. (See Figure 25.) In making this adjustment we automatically bring the center of the tumor in the proper plane (by moving the table along the tracks).

Setting the vertical scale is a little more complicated. Using the floor as a plane of reference, we determine the height of the point *J* by means of the device shown in Figure 26. The part *G* is movable horizontally along *B*, and the latter can slide up and down along *A*. The whole is attached temporarily to the table, which is provided with suitable lugs *L*. The device thus constructed enables one to place *P* at any point on the patient's body. A centimeter scale attached to *A* is set so as to read directly the height of the point *P* from the floor. The vertical beam supporting the tube holder is provided with an additional scale *R* rigidly attached to it and reading from the floor upward. The movable scale *S* runs parallel to this, and its zero can be set at the mark on *R* corresponding to the point *J*, to which *P* is set. A pointer, attached to the carriage *G* (Figure 16) and corresponding to the focal spot of the tube, runs on the scale *S*.

Having set in this manner the two scales with reference to the patient, the rest of the procedure is simple. The diaphragm is

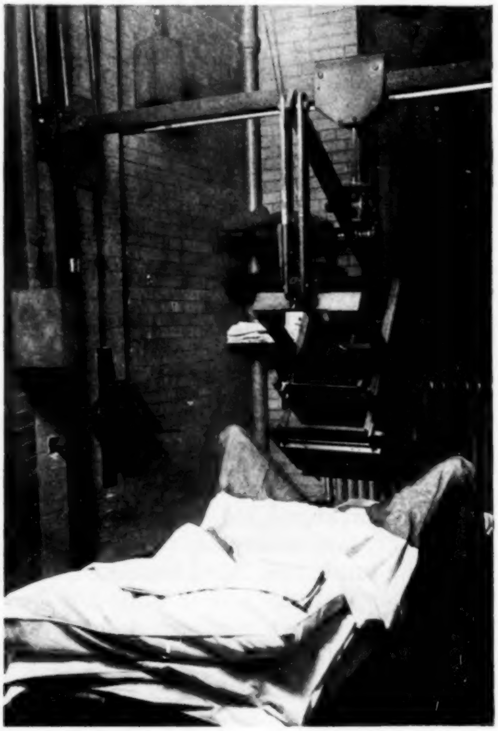
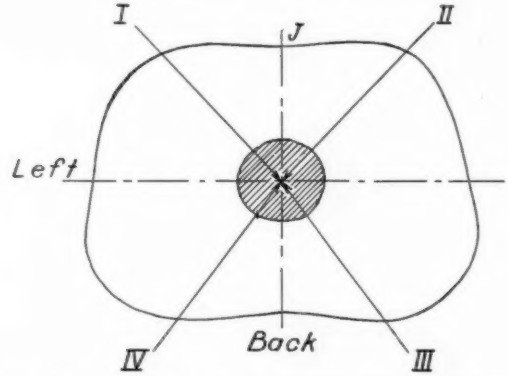


Fig. 23.

adjusted to the required size and the proper filter is put in place. The tube holder is set to the value of the angle B,[1] appearing on the contour chart. Then the whole is raised (or lowered) to bring the pointer corresponding to the focal spot of the target to the value of y on the scale S. Finally, the setting for the distance x is made on the horizontal scale. It is not necessary to measure the targetskin distance, because it is bound to be correct, if the work has been done properly. However, we may do so and use it as an approximate check on the accuracy of the setting.

In the above example, the contour chart was made for a section perpendicular to the longitudinal axis of the patient, and the beams of radiation for the different fields had their central rays in this plane. For the particular case considered, this was not only the simplest arrangement, but also the most desirable. In general, however, one should be able to give treatments in any direction, and the method adopted for setting up the patient must conform with this essential requirement. The objective method which we have developed is of general applicability, but the procedure for oblique treatments

[1] With the tube holder described above there are two ways in which the proper setting for the angle B may be made. In one case the longitudinal axes of the patient and the tube are parallel and the tube is rotated about this axis. In the other case the lateral axis of the tube is parallel to the longitudinal axis of the patient and the tube arms move in a plane perpendicular to the patient. For short target-skin distances the second way has the advantage that it brings the tube terminals further away from the patient.



Field No	T-S Dist. cm.	Field Area cm²	Filter mm. Cu.	Coordinates x cm	Coordinates y cm	Coordinates B degrees
I	50	25	0.5	44	35.4	43.2
II	"	"	"	"	"	"
III	"	"	"	38.3	41.3	36.2
IV	"	"	"	"	"	"

Fig. 24.

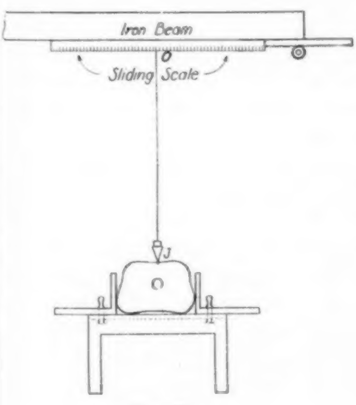


Fig. 25.

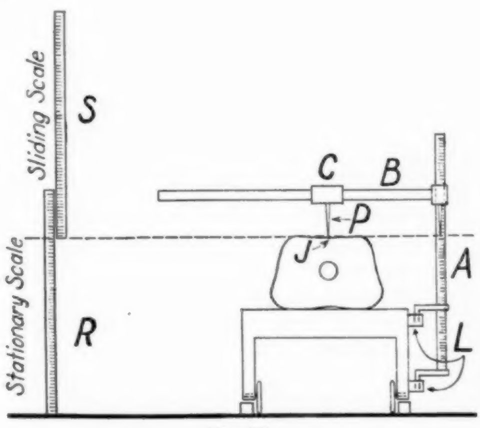


Fig. 26.

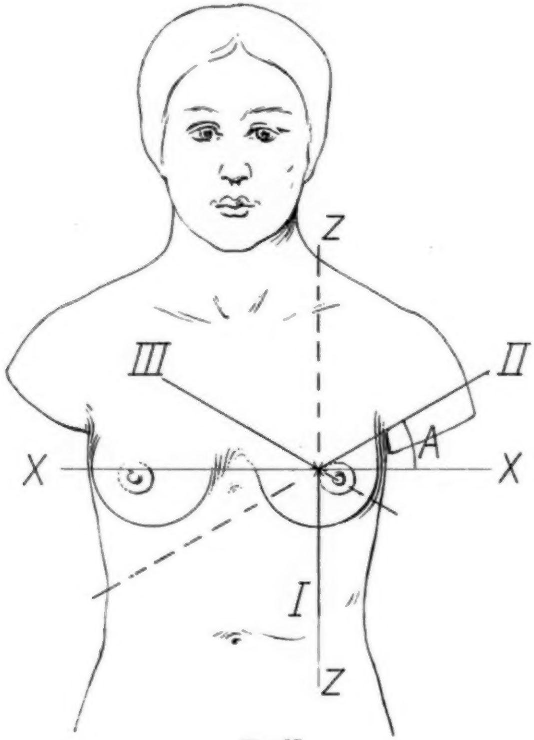


Fig. 27.

is a little more complicated than the one described above. We shall give a brief outline of it by considering a hypothetical case as an illustration.

Let us assume that we wish to irradiate a large breast with three fields as shown in Figure 27, the central rays I, II, and III forming the edges of a pyramid with its vertex at the center of the tumor. Since I is in one of the reference planes (the YZ plane), the determination of the coordinates for this treatment is just as simple as for the example already worked out. There will be only three coordinates y, z, and B as shown in Figure 28. The procedure in the treatment room is the same as before, except that the setting for z is obtained by moving the table along the tracks a distance z from the zero position.

For treatment II (or III), three linear and two angular coordinates

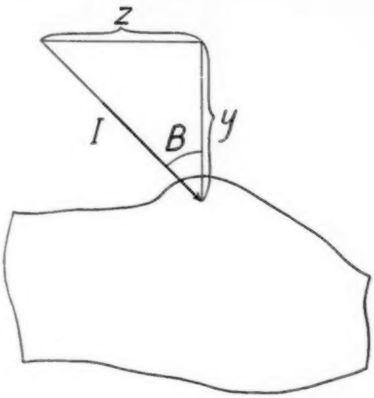


Fig. 28.

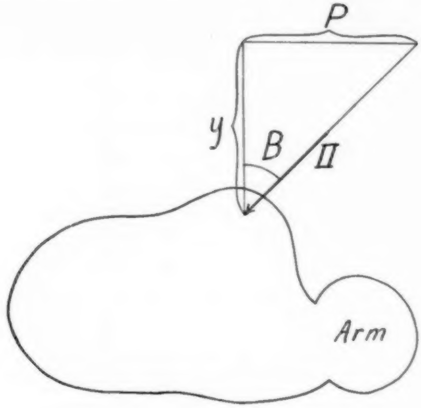


Fig. 29.

are necessary. Their values are obtained as follows: In Figure 29 we have the patient's contour in the plane of II and the frontal axis (Y axis). This enables us to determine two of the coordinates, y and B, either by the full scale or the trigonometric method. It also gives us the value of the distance P. Looking at Figure 30 now, we find the relation which the distance P bears to the coordinates x and z whose values we wish to determine. It will be seen that $z = P$ sine A, and $x = P$ cosine A. Since angle A can be measured directly on the diagram of Figure 27, we can easily calculate the values of x and z. Or if we prefer, we can use the full scale method to determine them. To administer treatment II, it is only necessary to duplicate on the proper scales and dials in the treatment room, the values of the three linear coordinates, x, y, z, and the two angular coordinates A, B. The actual procedure is obvious and need not be described.

We mentioned previously the fact that it is always theoretically possible to place the patient in the treatment room so that the contour section we are considering is in the plane of the vertical and horizontal (y and x) axes. To be able to do this for all possible treatments, however, the room must be considerably larger than indicated in Figures 20—22. Furthermore, in order to set the patient in the proper zero position, the treatment table would have to be shifted about the room a great deal, and this would not be very convenient. In institutions where a large number of patients is to be treated, it is important to set up the patients in the shortest possible time. In view of these considerations we feel that the method

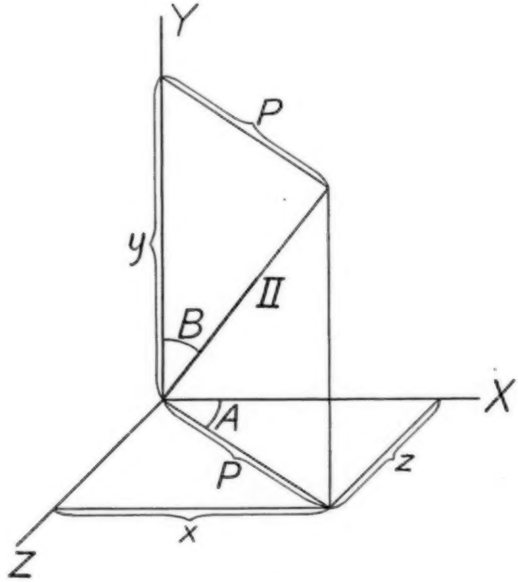


Fig. 30.

outlined above is preferable. The determination of the five coordinates is really a simple procedure, in spite of its apparent complexity. Furthermore, it should be noted that the time required to determine the coordinates is immaterial. This work can be done at any convenient time before the date set for the treatment, without interfering in any way with the use of the X-ray machine.

We have seen that for each treatment in a normal section only three coordinates appear on the contour chart. We shall point out now that the other nine are also used, although we may not be conscious of it. With the apparatus described here, when we place the patient on the table we really assign definite values to the angles α, β, γ, previously mentioned. When we set the center of the tumor in the zero position, the linear coordinates x_o, y_o, z_o, assume definite values with respect to the room, as a system of reference. When the position of the focal spot is set we employ two linear coordinates (given on the chart) and a third which is zero. Finally, while only one angle appears on the chart, the other two dials must be set at zero,[1] or the beam of rays will not be properly oriented.

[1] One might be set at 90 degrees; see footnote on page 108.

III. Errors and Experimental Check

The apparatus described in this paper was devised for the purpose of increasing the precision of the administration of X-rays. It may have occurred to the reader that in introducing so many scales and dials in the treatment room, we may have increased the chances for error. While it is true that there are more sources of error, it should be remembered that if the work is done with reasonable care, each error will be very small, and the total error in the final result will also be very small. This conclusion is justified inasmuch as there is no particular difficulty in determining the coordinates and in reproducing their values in the treatment room.

This, of course, presupposes that the different scales and dials of the apparatus are properly set, and measures must be taken to make sure that such is the case. We shall describe now the methods employed in making the most important settings.

1. *Adjustments*

We decided at the outset that the most direct way of checking the apparatus would be to determine the position of the X-ray beam itself. For this purpose we constructed a small ionization chamber which, in conjunction with a galvanometer, indicates the presence of a small beam of rays.

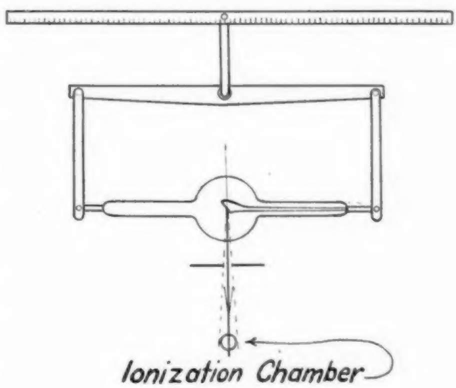


Fig. 31.

The Coolidge tube is placed in the holder with the focal spot as nearly as can be estimated at the point of intersection of the three axes of rotation. The scales and dials are set carefully in their geometrical positions. Then, using a plumb bob, the ionization chamber is placed with its center directly below the zero of the scale on the horizontal beam supporting the tube holder, that is the X scale. The holder is brought to its zero position on this scale and all the angles are set at zero, (Figure 31).

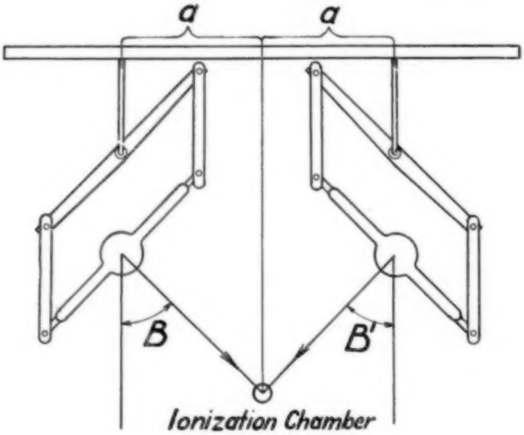


Fig. 32.

With the diaphragm wide open we obtain the galvanometer deflection for the beam of rays passing through the chamber. Then the diaphragm is adjusted to give a beam just large enough to cover the ionization chamber, and another galvanometer measurement is made using the same X-ray output as before. If the axis of this beam coincides with the position previously occupied by the plumb bob, the galvanometer will show the same deflection as with the large beam. If this is not the case, either the tube is not in the proper position, or some of the dials are incorrectly set. What to do from this point on depends on the findings, and it would be out of place to give here all the details of the procedure. We may say, however, that if the tube holder is properly constructed, the correct alignment can be obtained by shifting the position of the X-ray tube. After the necessary adjustments have been made, the axis of the beam of radiation should always coincide with the (imaginary) plumb line passing through the scale zero, when the tube holder is rotated about its vertical axis.

Additional tests for the dial settings may be made in the following manner: Leaving the ionization chamber in the same position as for the previous test, and the diaphragm set for a narrow beam, the tube holder is moved a distance *a*, say 50 centimeters, along the horizontal beam. Starting with all the dials set at zero, the holder is turned through an angle *B* (Figure 32), for which the galvanometer shows the maximum deflection. This indicates that for this setting the axis of the beam of rays passes through the center of the ionization chamber. Then the holder is moved to the same distance *a* on the opposite side of the zero mark and the angle *B'* is determined by finding the position for which the galvanometer shows the maximum deflection. If this dial is properly set the values of *B* and *B'* will be identical. A similar procedure may be used to check the other dial.

The scale *R*, Figure 26, which is to be permanently attached to the vertical beam, may be set by sighting along two points at the same height from the floor. If the latter is not level, the horizontal beam should be used as a line of reference. The fixed vertical scale and the device for determining the height of the point *J*, Figure 26, when the patient is set up, should be checked together. Methods for doing this are obvious.

2. *Experimental Check of Method*

Having made the tests and adjustments described above (and some others which naturally suggest themselves), we know that the apparatus is properly set up. This implies that the coordinates of a treatment can be reproduced in the X-ray room without appreciable error. It is desirable, however, to check experimentally the method as a whole, in addition to the apparatus. In this connection it should be noted that in the administration of X-rays to a patient there are many factors which are refractory to accurate measurements. Accordingly, the objective method, with which we are chiefly concerned in this paper, should not be expected to include such factors. In effect this method is intended to take care of the following part of the general problem of X-ray technique: On the patient's contour chart are marked the positions of the tumor and the X-ray beam to be employed. *Irrespective of whether these are correctly located or not*, our method supplies the means for pointing the X-ray tube in such a way as to be reasonably sure that the beam of radiation passes centrally through the tumor, *wherever this may be assumed to be.* The method is objective, inasmuch as *any radiologist* familiar with it can reproduce the direction of the X-ray beam with respect to the patient, at any time, and anywhere. It is evident, therefore, that a fair test of the accuracy of the method may be made by assuming a certain position for the tumor, pointing the tube according to the procedure outlined above, and determining the orientation of the beam with respect to the tumor.

For this purpose we constructed a hollow phantom (Figure 33) having an elliptical cross-section comparable to that of a patient. In this we attached a wooden board with many holes corresponding to hypothetical tumors. We then made a contour chart reproducing the positions of the holes, and prescribed »treatments» for each hole. The values of the respective coordinates x, y, and B were obtained by means of the board of Figure 13. The phantom can be placed on the treatment table, a small ionization chamber is attached to the hole to be »irradiated», and the tube holder is set in position

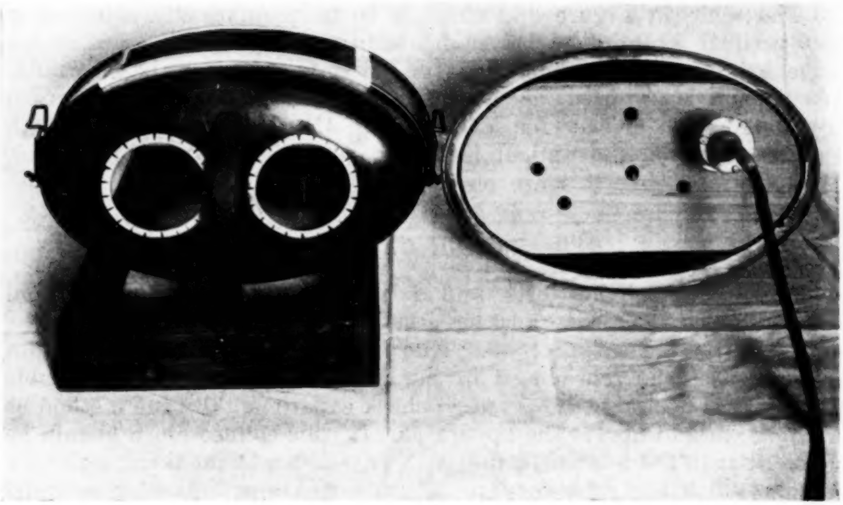


Fig. 33.

according to the values of x, y, and B. Using a small beam of radiation one can tell by means of the galvanometer whether the rays go through the ionization chamber or not. By taking one additional reading with the diaphragm wide open, one gets an approximate idea as to whether only part of the beam strikes the chamber. An accurate determination of the position of the central ray can be made by shifting the tube holder in steps of one-half or one degree on either side and reading the galvanometer for each setting. Plotting the results on cross-section paper a curve similar to the one in Figure 34 is obtained. The peak of the curve corresponds to the angle setting for which the central ray passes through the center of the chamber. Several tests made with the phantom for different »tumor» positions showed that the desired »treatments» were administered with very good precision. The results permit us to state that the probable error in the position of the central ray is considerably less than one centimeter on either side of the center of the tumor, for a target-skin distance of 50 centimeters.

The curve of Figure 34 represents a test made several weeks after the tube holder had been in daily operation, to find out whether any shift in the settings had occurred. The coordinates for the »treatment» were: $x = 21.5$ cm., $y = 47.6$ cm., and $B = 22$ degrees. The tube was set accordingly and then the angle was shifted to

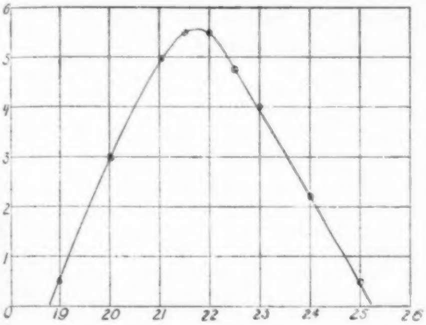


Fig. 34.

either side of the 22 degree mark, to the values shown by the circles on the curves. It will be seen that the maximum deflection of the galvanometer corresponds to $B = 21.75$ degrees. The error in the orientation of the beam was, therefore, 0.25 degree. For a tumor depth of 10 centimeters and a target-skin distance of 50 cm., one degree corresponds to a linear shift of $\frac{2 \times 3.14 \times 60}{360} = 1.04$ cm. on the circumference. Hence the central ray in the above case passed through point $(0.25 \times 1.04 =)0.26$ centimeter to one side of the center of the »tumor». It will be acknowledged that this is very good precision for this type of work.

3. *Comparison with Ordinary Methods*

The phantom and ionization chamber[1] described in the previous section enable us to determine the error in alignment when the tube is pointed by eye in the ordinary way. The tests were analogous to the ones already described, except that in each case the tube was set up by a radiologist. To get data which could be representative of average conditions, several radiologists were asked to cooperate with us, and some of the tests were made with their own X-ray equipment.

In reproducing a treatment indicated on the contour chart, there are three ways in which errors in alignment may appear: (1) The angle at which the beam enters the patient may be different from the one represented on the chart, although the central ray passes through the center of the tumor. (2) The angle may be correct, whereas the central ray passes to one side of the tumor. (3) Both errors may be present simultaneously. Our tests show that the error in orienting the beam of rays to the desired angle is in the neighbourhood of $\pm$ 5 degrees. That is, if the radiologist attempts to set the tube holder by eye so that the beam makes an angle of 24 degrees with a vertical line, the angle may actually be 19 degrees, or 29 degrees. The probable error in the alignment of the

[1] Instead of the ionization chamber, photographic films were used for some of the tests mentioned here.

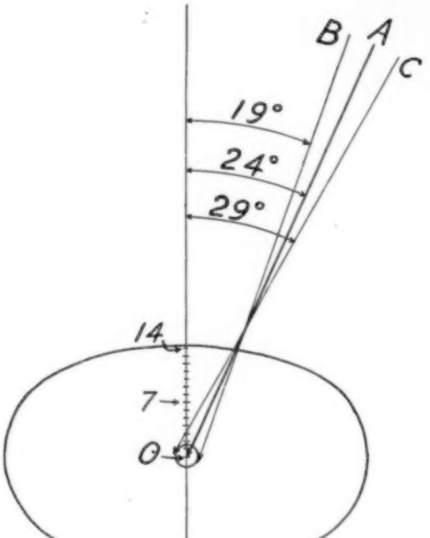


Fig. 35.

beam, independently of the angle, is about two centimeters on either side of the center of the tumor, for oblique positions of the X-ray beam.

The effect which these errors have on the distribution of radiation within the patient's body depends to a large extent on the size and number of the fields employed. With small fields the tumor might be practically outside the geometrical beam. In any case, however, the dose which normal tissues receive is bound to be affected. This may be best illustrated by an example.

Figure 35 shows a contour chart on which we have specified a treatment in the direction of the heavy line, with a target-skin distance of 50 centimeters, a field of 50 square centimeters, and a filter of 0.5 millimeter of copper. If the tube is pointed by eye, both the angle and the position of the central ray may be in error, as indicated above. We shall take two of the possible directions in which the treatment might actually be given, and compare the distribution of radiation along the vertical line (Fig. 35), at points 1, 2, 3, 4, . . . 14, one centimeter apart. But in order to make a very fair comparison, we shall assume that, when the angle is smaller than the prescribed value, the beam passes on one side of the tumor, and when it is larger it passes on the opposite side. Furthermore, we shall assume that the central rays of the two beams miss the center of the tumor by only 1.5 cm. The two are shown in Figure 35 as *B* and *C*. By means of the dosage chart corresponding to the treatment factors given above, we determine now the doses at points 1, 2, 3, etc. for each of the three positions shown. The values are given in Table I. It will be seen from the last column that for points near the center of the tumor (0 to 5 cm.) the difference is not large, but for other points it is very considerable. If we bear in mind that this variation is due to a relatively small shift in the position of the beam of rays, and that there are other factors which may increase it, we may conclude that a difference

Table I

Points on Vertical (1 cm. apart)	Dose					Percent Difference between B and C
	Correct Beam A	Beam B	Percent of value for A	Beam C	Percent of value for A	
0	20	20	100	19	96	4
1	22	23	104	22	100	4
2	26	26	100	25	96	4
3	30	29	97	28	93	4
4	34	33	97	33	97	0
5	39	35	90	38	98	8
6	42	34	81	42	100	19
7	44	35	80	48	109	29
8	40	35	88	50	125	37
9	38	34	90	49	129	39
10	37	32	87	40	108	21
11	35	28	80	38	109	29

of 50 percent at some points is not unlikely. It should be noted that these points, being close to the surface, receive large doses, to which living tissues cannot be indifferent. Variations of this type in the distribution of radiation assume greater importance when we consider how little is known definitely about the effects of radiation on different organs and tissues. If the same treatment is prescribed for two clinically similar cases, but unsuspected variations occur in the administration of the treatments, we may get different results depending on what normal tissues are, or are not, irradiated. We would naturally attribute the discrepancy to biological differences in the two patients. While it may be true that the difference in the treatments actually administered had nothing to do with the difference in the results obtained, we cannot take this for granted. Hence if such comparisons are to be of scientific value, it is essential that the treatments be identical in all respects — as far as our knowledge permits.

4. *Additional Errors*

In using a rigid phantom like the one of Figure 33, there is no difficulty in adjusting the horizontal and vertical scales to read zero at the point J (see Figure 12), which is marked on the surface of the phantom. On the other hand, the contour of a patient is al-

ways more or less plastic, and in general is affected by the position of the body. Great care must be exercised, therefore, to minimize errors in the scale zeros. In this connection it is useful to remember that the point J is always directly above the center of the tumor. If the patient is made to lie on the treatment table in the same posture as when the contour chart was made, and the latter is consulted while the patient is being set up, the reference point can be located quite accurately. Nevertheless we cannot expect the same accuracy in the orientation of the X-ray beam as was demonstrated with the phantom. We are planning some additional apparatus to facilitate this procedure. In the meantime, we may say that the error from this source is not very large, even under the worst conditions. If we remember that the position or extent of a tumor in the patient's body is subject to considerable uncertainty, and that allowances must be made therefor, we may safely state that the error is within the limits foreseen and allowed for on different grounds.

So far we have referred only to errors which influence mainly the position of the beam of radiation with respect to the tumor. It is important to consider also the factors which affect the distribution of radiation within the patient's body. The dosage charts for different target-skin distances, field areas, and filter thicknesses which we have, were determined under definite experimental conditions, and the depth doses indicated thereon apply only for these conditions. Accordingly, the distribution of radiation within the patient's body will not be as mapped out on paper unless we make sure that the same conditions obtain for the treatments. To reproduce them exactly is practically impossible, and the best that we can do is to approximate them as closely as we can.

The chief difficulty lies in duplicating the configuration and the composition of the irradiated volume. In the experiments from which the charts were determined, the water phantom employed was $30 \times 30 \times 35$ cm. Therefore, in giving a treatment, the part of the body to be irradiated should be built up to this volume, the skin at the port of entry serving as one side or part of one side. The material to be used for this purpose should have the same absorbing and scattering power for X-rays as water. Many substances such as paraffin, beeswax, dough, water-bags, etc., have been suggested, especially by German radiologists, chiefly for the purpose of increasing the amount of scattered radiation. They fulfil the requirements of our problem but they are not very convenient to use. We have been testing some granular materials, such as rice or wheat, mainly with the idea of shortening the time required to build up the part

irradiated, but so far we have not found a suitable material. Perhaps a satisfactory combination of two or three substances will be found later. Nevertheless this manipulation probably will always be troublesome, and the best we can do is to have several materials available, so that the most suitable ones may be chosen for any particular case.

We are planning to attack the problem from a different angle by determining just what influence the volume of the phantom has on the depth doses, for different field areas. When this information is available we can base our doses on the distribution charts corresponding to the volume of the part to be irradiated.

Passing now to a consideration of the influence which the composition of the medium between the surface and the tumor exerts on the distribution of radiation, we come to the most elusive factor in the problem. In determining the dosage distribution charts, water was used as the absorbing medium, on account of the fact that it approximates closely the predominant body tissues. However, the similarity is not so close for some tissues, such as fat, lung, and bone. Furthermore, there are air spaces in some parts of the body, whose volume and location are hard to ascertain, or even estimate, but which have a marked influence on the distribution of radiation. These cannot be ignored, and yet accurate corrections cannot be made with our present knowledge. We can, however, make reasonable allowances which will enable us to say with considerable definiteness that the dose delivered to a tumor, or any specified point, is between a lower and an upper limit (for example, between 60 and 70 percent). To be able to make a better estimate of this character, we are planning a series of comparative tests, making measurements with water phantoms and the patients themselves.

So far we have said nothing about the accuracy and precision of the dosage charts themselves. Two types of errors are present there: (1) errors inherent in the method of measurement employed, which affect the *accuracy* of the charts; and (2) experimental errors more or less present in all measurements, which affect the *precision*. If the experimental work is done carefully the latter errors are small and can be neglected. Their presence and magnitude can be ascertained during the progress of the work by determining how closely results can be duplicated from time to time. On the other hand, errors caused by the method of measurement adopted are very difficult to estimate, especially where biological factors are involved. For this reason it may be well to discuss this type a little more in detail.

Each curved line in a dosage chart represents points at which

he »dose» is the »same» under certain definite experimental conditions. Whether this is true or not depends entirely on the definition of »dose». For instance, if we postulate that two doses cannot be equal unless the quality of the radiation is identical, the dose at every point in the water phantom probably is different. What we ordinarily mean by equality of dose is really equality of effect, — physical, chemical, biological, or otherwise. But since there is no general one to one correspondence for all these effects, it follows that the distribution of radiation in a dosage chart must depend on the effect used as a basis of measurement. In radiation therapy the ultimate aim is to cure the patient. In this it is certain that a great many factors are involved, each of which may be affected differently by radiation, both as regards the *type* of effect, and the *degree*. Accordingly we cannot, for the present at least, have dosage charts based on the effects we wish to produce.

It is generally agreed that, so far at least, ionization measurements made under the proper conditions, supply the best information for purposes of dosage. This is the method we used in determining the relative depth doses along the central ray for our dosage charts. The experimental error for the conditions we employed is small. The distribution sideways and outside the geometrical beam was determined by a special photographic method which was carefully controlled. We feel sure, therefore, that the charts do not contain substantial errors for our experimental conditions. Whether the desired biological effects are proportional to the doses indicated thereon is another question, which, unfortunately, will not be answered for a long time. We wish to point out, however, that this does not decrease the usefulness of the charts. They supply the only means of estimating the distribution of radiation within the patient's body — which is an essential pre-requisite for the correlation of »cause» and »effect».

Furthermore, we wish to emphasize that, whatever uncertainty there may be about the dosage charts, it does not militate against the use of an accurate method of pointing the X-ray tube. If we do use it, we have on the contour chart a permanent and reliable record of the actual fields employed and related data. Hence, at any subsequent time we can re-determine the dosage distribution in the light of whatever new information we may possess. Without such data it is practically impossible to make even a rough estimate of the dose delivered to a given point in the patient's body.

It is hardly necessary to mention that errors are always present in the voltage and milliampère settings. It is desirable not only to minimize these errors, but also to make sure that the spark gap and

meters are properly calibrated. Comparisons between different machines cannot be made unless account is also taken of the wave form. The most satisfactory way is actually to measure the quantity and quality of the X-ray output with a good ionization instrument. This takes care also of variations among tubes due to age or other causes.

It will be readily seen that all the care and thought spent in working out a treatment and setting up the patient, are completely wasted if the patient shifts the position of his body during the irradiation. Still, this is practically certain to be the case when the treatment lasts one hour or longer, unless special precautions are taken. The only way to insure immobility is to prevent the possibility of motion; but whatever provisions are adopted to bring this about, they must not cause too much discomfort to the patient. We believe that the desired result can be obtained by fixing quite rigidly the part of the body to be treated, allowing at the same time a reasonable freedom of motion to the rest of the body. With this end in view, we have provided two wooden angles 25 centimeters wide, which can be attached to the treatment table at any desired point, (See Figure 25). Each is held in place by a wooden screw and a nut, the screw passing through a lateral slot running the full length of the table. The side of the angle which bears on the table is also slotted, permitting the angle to be fastened at different distances from the center. With these provisions the angles can be brought to any part of the patient's body, and when clamped down will effectively preclude sidewise shift. If necessary, straps may be used to prevent upward motion. No provision is made to obviate a slight motion of rotation because this is not very likely to happen, and in general is not serious. A very flexible tube holder being available, the patient can be made to assume the most comfortable posture on the table for practically any treatment, and the tendency to turn is reduced to a minimum. Furthermore, if lateral motion is prevented, a slight turn is not serious because in deep therapy the tumor in general would not be very far from the center of rotation. The use of these angles makes it impossible to have the customary mattress on the table, but pillows can be used instead.

IV. Summary and Conclusions

In planning a quantitative study of some phenomenon, the physicist considers carefully what precision is required in the results and then adops suitable methods for the measurement of the different quantities involved. The degree of precision desired for each measure-

ment depends on the influence which the particular magnitude in question will exert on the final results. Since, in general, the greater the precision sought the more complicated is the procedure, it is more economical not to employ methods which give greater precision than is needed.

We have described a method of administering X-rays which enables the radiologist to point the tube with great certainty in any predetermined direction relative to the patient. We have then pointed out many sources of error which limit very seriously the accuracy of X-ray dosage. Thus the question naturally arises, whether our method is unnecessarily "refined". Or, more specifically, we must determine whether there is a proper balance between the advantages and the expenditure of labour and time entailed in the use of our method.

If we trace the development of X-ray dosage technique during the last fifteen years, we find a gradual and marked improvement. The most important single step was perhaps the introduction by FRIEDRICH of means for the measurement of depth doses. The large amount of experimental work which has been done since then, furnishes definite data about the distribution of radiation in a medium such as water, which is quite comparable to the predominant body tissues. In the light of this information, the radiologist has been gradually changing his point of view in regard to dosage. He pays more and more attention now to the distribution of radiation within the patient's body and the effects which are produced in normal as well as pathological tissues.

In accordance with these new developments, at the present time many radiologists make a contour chart of the patient to be treated, locating as accurately as available knowledge permits, the region of probable involvement. Then, by means of dosage charts, the fields to be employed are determined, and a fair idea of the distribution of radiation is obtained. As pointed out before, however, it is essential that the relative position and orientation of the beams of radiation actually used in treating the patient, be as indicated on the contour chart. It is this step in dosage technique that we wish to provide by the method we advocate. We feel that, if the dosage technique is to be as outlined above, this step cannot be overlooked without seriously impairing the usefulness of the whole. Taking for granted, therefore, that some means must be provided for the correct duplication in the X-ray room of the treatments planned on the contour chart, we shall discuss the merits and demerits of the method we propose.

It will be readily conceded that it is desirable to substitute an

objective method for setting up the patient for the largely subjective one generally employed. To do this, it is necessary to provide some special apparatus, although it need not be the same as that which we have described. The essential requisite in the treatment room equipment is simply the provision of suitable scales and dials to set the linear and angular coordinates of the treatment. A certain flexibility of the apparatus is required in order to bring patient and tube into the proper relative positions, no matter what method is employed. At the same time the different modes of motion may be arranged in such a way as to facilitate the procedure as much as possible. For the determination of the coordinate of a treatment, all that is necessary is a centimeter scale, a protractor, and a table of sines and cosines, which can be procured easily.

The special projection lantern and slides of anatomical cross-sections mentioned in the first part of the paper are not essential in-so-far as the method discussed above is concerned. But we believe that the scheme is of considerable help in fixing the position of the tumor on the contour chart, which, of course, is important in the general problem of dosage.

We shall consider now the question of time. With our equipment, the time required to set up the patient in the treatment room is the same for the new as for the old method. But this does not include the time necessary for the determination of the coordinates from the contour chart. Having had a little experience, however, one can do this work rapidly. At any rate, it is something which can be done at a convenient time before the date set for the treatment, without interfering in any way with the efficient use of the X-ray machines. If, furthermore, a competent and reliable technician is available, this work can be entrusted to him almost entirely. The technician can also complete the tube adjustments after the radiologist has set the patient in the zero position, this being the only difficult part in the procedure.

In view of these considerations we may conclude that the additional equipment and time required by the use of our method are not out of proportion to the advantages derived. In fact, if we take into account the work and time involved in the other steps of the process, the additional effort becomes insignificant. However, there may be a question in the minds of some radiologists about the practical value of the whole method of dosage which depends on the use of charts, etc. Others feel that by using large fields they obviate the necessity of pointing the tube with precision.

It seems to be the general consensus of opinion at the present time that what brings about a satisfactory clinical result is not only

the effect on the tumor tissue; but also the effect or effects on the normal tissues irradiated. If results are to be compared — and this is the crucial test of any changes in technique we may make, — it is of the utmost importance that we have a definite idea of the doses which the tumor and adjoining tissues receive. It is by a careful analysis of the cases treated under various conditions, and a correlation of dose and effects in different tissues, that we can hope to improve the clinical results. If large or small fields are preferable will be determined solely on this basis. But no true comparison can be made unless we are sure of the orientation of the the X-ray beams within the patient's body, particularly the narrow beams.

In conclusion we wish to reiterate the importance of objective methods in the development of any branch of science. Fully aware of the difficulties which beset the radiologist, we feel, nevertheless, that great progress can be made in radiation therapy by a systematic effort to substitute objective for subjective methods in the administration of treatments. In the present paper we have set forth our attempt in this direction, in-so-far as a small part of the vast problem is concerned. We realize that the practical procedure is susceptible of improvement, and we shall endeavour to develop it further in accordance with the dictates of experience.

SUMMARY

1. The following steps are involved in the administration of X-ray treatments: a) Making of a contour chart of the patient's body at the tumor level. b) Locating the area of probable tumor invasion on the contour chart. c) Deciding what dose to give to the tumor and surrounding tissues, and what parts, if any, should be protected as much as feasible. d) Determining the position, number, and attributes of the radiation beams which will be required for the desired treatment. e) Estimating the distribution of radiation within the patient's body. f) Reproducing in the X-ray room the treatment mapped out on the contour chart.

2. This paper deals chiefly with the last step, f. a) A geometrical method is described whereby the patient and the tube may be placed in the proper relative positions to duplicate the treatment conditions specified in the contour chart. b) The essential requisites of the treatment room equipment are set forth, and a convenient practical arrangement is described. c) The actual procedure is outlined for typical cases.

3. A discussion of many errors which limit the accuracy of X-ray dosage is given. a) In particular the errors which affect the precision of the geometrical method are analyzed and experimental checks furnished.

4. The advantages of the method are set forth. a) Special stress is laid on its objectiveness.

5. A method for the localization of the tumor on the patient's contour chart is given incidentally. a) It makes use of a projection lantern which

superimposes the corresponding anatomical cross-section on the contour chart with the proper magnification to insure a closer coincidence of the two outlines. b) The view of the organs in their relative positions facilitates the localization of the tumor area on the chart.

ZUSAMMENFASSUNG

1. Die Durchführung einer Röntgenbehandlung umfasst folgende Akte: a) Anfertigung einer Konturzeichnung vom Körper des Patienten im Niveau des Tumors. b) Lokalisation des Gebietes der wahrscheinlichen Tumorausbreitung auf der Konturzeichnung. c) Beschluss über die Dosis, die man auf den Tumor und die umgebenden Gewebe einwirken lassen will und eventuell über die Partien, welche so viel als möglich zu schützen wären. d) Feststellung der Richtung, Zahl und Eigenschaften der Strahlenbündel, die für die gewünschte Behandlung erforderlich sind. e) Schätzung der Strahlenverteilung im Körper des Patienten. f) Verabreichung der Behandlung im Röntgenzimmer nach dem auf der Konturskizze eingezeichneten Plan.

2. Der vorliegende Aufsatz beschäftigt sich hauptsächlich mit dem letzten Akt, f. a) Es wird eine geometrische Methode beschrieben, durch welche Patient und Röntgenröhre in die richtige gegenseitige Stellung gebracht werden können, um die Behandlungsbedingungen, so wie sie in der Konturskizze spezifiziert sind, herzustellen. b) Auseinandersetzung über die notwendigen Requisiten für das Behandlungszimmer und Beschreibung einer zweckmässigen praktischen Anordnung. c) Darstellung des gegenwärtigen Verfahrens für typische Fälle.

3. Erörterung einer Reihe von Fehlerquellen, welche die Genauigkeit der Röntgenstrahlendosierung einschränken. a) Analysierung und Angabe experimenteller Kontrolle der Fehler, welche speziell die Präzision der geometrischen Methode beeinträchtigen.

4. Anseinandersetzung der Vorteile der Methode. a) Besonderes Gewicht wird auf ihre Objektivität gelegt.

5 Nebstbei wird eine Methode zur Lokalisation des Tumors auf der Konturskizze des Patienten vorgelegt. a) Zu diesem Zweck wird eine Projektionslaterne benützt, welche den entsprechenden anatomischen Querschnitt unter geeigneter Vergrösserung auf die Konturskizze projiziert, um eine genauere Übereinstimmung der beiden Umrisse zu sichern. b) Das wahrnehmbare Bild der Organe in ihrer gegenseitigen Lage erleichtert die Lokalisation des Tumorgebietes auf der Skizze.

RÉSUMÉ

1. L'application des divers traitements röntgenologiques comprend les temps suivants: a) Exécution d'un croquis de contours reproduisant le corps du malade au niveau de la tumeur. b) Localisation, sur le croquis de contours, de la zone d'invasion présumée de la tumeur. c) Détermination de la dose à appliquer à la tumeur et aux tissus environnants, ainsi que des régions, s'il en existe, que l'on devra protéger autant que possible. d) Détermination de l'incidence, du nombre et du caractère des faisceaux de rayons nécessaires au

but thérapeutique poursuivi. e) Appréciation de la dispersion de l'irradiation dans l'organisme du malade f) Exécution, dans la chambre d'irradiation, du traitement indiqué sur le croquis de contours.

2. Ce document se rapporte plus spécialement au temps f. a) Description d'une méthode géométrique indiquant la position réciproque du malade et de l'ampoule que l'on doit adopter pour reproduire les conditions de traitement spécifiées sur le croquis de contours. b) Enumération des conditions nécessaires d'installation de la chambre d'irradiation et description de dispositifs pratiques. c) Indication sommaire des procédés opératoires actuels répondant aux cas typiques.

3. Discussion des nombreuses sources d'erreur restreignant l'exactitude du dosage des rayons X. a) Analyse particulière des erreurs altérant la précision de la méthode géométrique et communication de sources expérimentales d'échecs.

4. Avantages de la méthode. a) Importance spéciale due à son objectivité.

5. Description, incidemment, d'une méthode de localisation de la tumeur sur le croquis de contours du malade. a) Elle consiste en l'emploi d'une lanterne de projection à l'aide de laquelle on superpose une section transversale de la région anatomique correspondante sur le croquis de contours, à une échelle permettant de faire coïncider exactement les contours extérieurs des deux figures. b) La vue des organes dans leur position relative facilite la localisation de l'étendu du néoplasme sur le croquis.

A PORTABLE INSTRUMENT FOR THE MEASUREMENT AND REGISTRATION OF X-RAY INTENSITY

by

Rolf M. Sievert, Stockholm

When the running conditions (milliampère, kilovolts) of the X-ray tube have been ascertained, and dosage measurements carried out, it is necessary, and in most cases sufficient, to control the radiation once or twice a month in order to see if it remains constant. For this purpose a reliable instrument is desirable to answer the following requirements as far as possible.

1) The intensity values must be sufficiently accurate.
2) Quick measurements must be obtainable.
3) The instrument must not be susceptible to damp or temperature, but able to stand hard usage and be easily portable.
4) It must be possible to read the intensity on a technical instrument (e. g. milliampèremeter).
5) An automatic registration of intensity variations is desirable.

It would also be of great advantage, if, when using X-ray radiation of different qualities the values obtained go as far as possible parallel with the biological effects.

An instrument more or less fulfilling these requirements has been constructed and tested at the Physical Laboratory of the »Radiumhemmet».

The principle of the instrument will be seen from fig. 1. The ionization current in a large chamber I passes over a sensitive galvanometer G to the earth. To the galvanometer an ordinary compensation arrangement is connected, by which the action of the ionization current is balanced. This is done by varying the resistance V, and consequently also the current intensity in resistance box R, until the galvanometer points to zero. Different measurement ranges can be obtained by changing the resistance in box R. The readings of a precision milliampèremeter multiplied by the resistance in box R

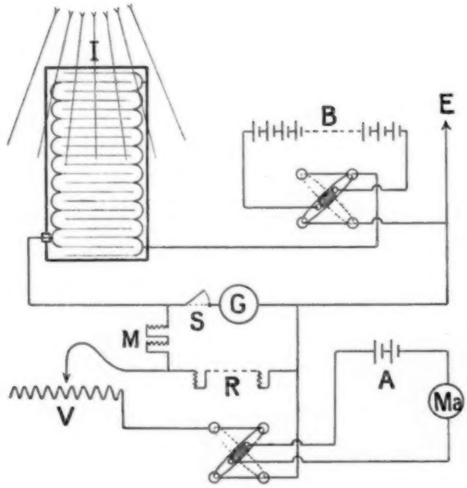


Fig. 1.

(1—50 ohms) give the radiation intensity in relative units. A resistance box of 100,000 ohms is placed at M, and the apparatus is earthed at E.

The ionization chamber I consists of a wooden case 25×25×60 cm. lined with aluminium foil. In order to prevent the voltage necessary for the production of the saturation current from being too high, the chamber is fitted with a set of aluminium foil plates. Every second one of these plates is connected with the aluminium lining and with one of the terminals of a battery B, the others being insulated with ebonite and connected with the galvanometer. The distance between the plates is about 12 mm. The chamber should be so placed that its top surface (25 × 25 cm.) is 50 cm. from the target of the X-ray tube. One of the ends is reserved for a partition for keeping wires and measure-rules. The intensity values obtained must be corrected according to the barometric pressure, which is read from an aneroid barometer placed on the instrument board mentioned below.

An insulated wire runs from the ionization chamber to the galvanometer, which is mounted on a wooden stand together with the compensation arrangement. The galvanometer is constructed by Leeds & Northrup, Philadelphia, and consists of a Deprez-d'Arsonval instrument fixed up in a wooden box with a low tension lamp for objective readings. The deflexion of the galvanometer system is to be seen on a transparent glass scale on one of the walls of the box. The instrument is not very susceptible to outward action, it does not require any clamping arrange-

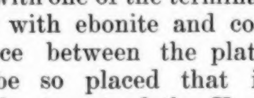


Fig. 2. The apparatus ready for transport.

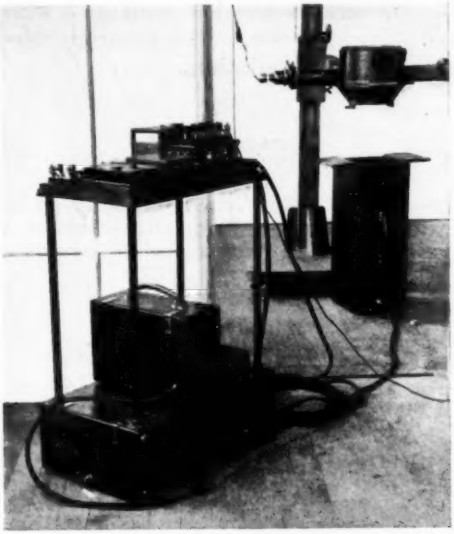


Fig. 3. The apparatus ready for use.

ment, and it possesses a sensitivity of about $2.5 \cdot 10^{-8}$ ampère pr. scale part.

The signs of the charging of the chamber, as well as the direction of the compensation current in the resistance R, can be changed by two reversing keys. A small battery B (164 volts) is used for charging the chamber and a lead accumulator A (4 volts) produces the current necessary for the compensation and illumination.

A photographic apparatus with a registration slide, fitted with a cylinder 240 mm. in circumference, and rotating once an hour, can be placed in front of the galvanometer. A curve recorded by the instrument will be seen in fig. 4. For the sake of comparison the primary voltage fluctuation is registered by the side of the same diagram, where it will be seen how the radiation intensity depends on the primary voltage.

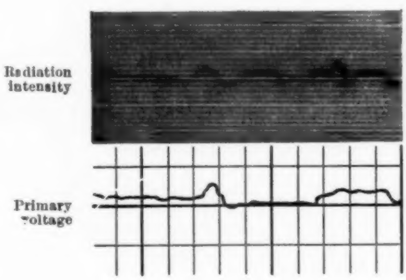


Fig. 4.

The accuracy with which the intensity of X-ray radiation can

be ascertained by means of the instrument described is 1—2 % at 4 milliampère and 180 kilovolts. The accuracy becomes still greater with increased intensity of radiation.

SUMMARY

For the purpose of controlling X-ray intensity an instrument has been constructed, which consists of a large ionization chamber, a galvanometer, and a compensation arrangement. A registration apparatus can be fixed to the instrument.

ZUSAMMENFASSUNG

Ein Instrument für die Kontrolle der Röntgenstrahlen-Intensität. bestehend aus einer grossen Ionisationskammer, einem Galvanometer und einer Kompensationsvorrichtung, wird beschrieben. An dem Instrument kann ein Registrierapparat angebracht werden.

RÉSUMÉ

Un instrument ayant pour but de contrôler l'intensité des rayons X, et se composant d'une grande chambre d'ionisation, d'un galvanomètre et d'une installation de compensation, est décrit. Un appareil d'enregistrement peut être monté sur le même instrument.

SERVICE RADIOLOGIQUE DE ONZE LIEVE VROUWE GASTHUIS, AMSTERDAM
DIRECTEUR: DR J. W. F. JANSEN

UN CAS DE CHONDROMATOSE UNILATÉRALE

(Maladie d'Ollier)

par

Dr. *J. W. F. Jansen*

(Tabulæ XXI—XXII)

Une fillette de neuf ans, déjà opérée deux fois pour un genu valgum, fut admise à l'hôpital par suite d'une récrudescence de l'affection. A part cela l'enfant qui ne se plaignait d'aucune maladie, paraissait saine et normale; son intelligence était bien développée.

Elle est l'ainée de la famille, née à terme de parents bien portants; elle a été nourrie au sein. Les deux premières années de sa

Fig. 1.

Fig. 2.

vie furent normales; la dentition se fit régulièrement et l'enfant avait 14 mois quand elle commença à marcher et elle n'offrit aucun signe de rachitisme. Peu de temps après que les deux ans furent révolus la mère se rendit compte que l'enfant tombait facilement au moindre obstacle; à trois ans la fillette commença à boîter. Elle ne fut alors ni examen ni traitement de façon particulière.

Elle a une sœur cadette, complètement normale. On ne signale dans la famille ni du côté paternel, ni du côté maternel aucune maladie spéciale.

Après un examen minutieux de l'enfant on constate outre la jambe en »X», qu'on avait essayé de redresser, les déviations suivantes:

la partie gauche de la face est plus petite que la droite;

la partie gauche de la cavité thoracique est aplatie et se soulève moins à la respiration que la partie droite;

le quatrième doigt de la main gauche est en forme de boudin;

l'auriculaire de la main gauche est raccourci et recourbé;

le bassin est dévié;

il existe une légère scoliose;

la cheville gauche intérieure fait saillie;

le talon gauche est plus gros que le droit;

les deuxième et troisième orteils du pied gauche sont enflés;

la taille de l'enfant est de 1 m 28, taille normale par rapport à son age. Il n'y a aucun indice de rachitisme, de myxœdème ou de dystrophie adiposo-genitale; l'hypophyse n'est pas agrandie.

Le résultat de l'examen radiologique du genou a déterminé l'examen radiologique complet de l'enfant. Sur les plaques radiologiques on constate à de nombreux endroits des tumeurs aussi bien sous-périostiques qu'intramedullaires. Elles étaient nettement limitées et facilement perméables aux rayons X.

On en trouve:

au sommet de la boite crânienne;

aux quatrième et cinquième côtes de gauche à la partie antérieure;

à l'auriculaire, au quatrième doigt et au cinquième métacarpe de la main gauche;

dans le fémur près du grand trochanter et au-dessus du genou; au sommet du péroné, à l'intérieur et à la surface; quant à la cheville extérieure elle ne présente qu'une masse enflée; dans le calcanéum du pied gauche, dans le troisième métatarse et dans les deuxième, troisième, quatrième et cinquième orteils gauches.

Toutes les tumeurs sont localisées au côté gauche; au côté droit on ne constate que quelques petites places suspectes au pied.

D'après l'image radiologique il se pourrait que nous eussions à

faire seulement à des chondromes et alors nous serions en présence d'un cas de la maladie décrite par OLLIER sous le nom de dyschondroplasie et appelée par WITTEK, qui n'avait pas pratiqué d'examen histologique »perturbation de croissance d'Ollier».

L'hypothèse des chondromes prend corps aussitôt après l'examen microscopique d'un fragment de tumeur prélevé lors de l'ostéotomie du fémur. Cet examen révéla que le tissu se composait de cellules de cartilages d'un type myxomateux, emboitées dans des capsules par groupes plus ou moins grands.

Autour de ces groupes de cellules se trouve comme tissu intermédiaire de la hyaline. Le tissu conjonctif manque complètement. Il est intéressant de remarquer au milieu de ces masses cartilagineuses des cellules de moelle où se trouve un vaisseau sanguin (Dr. VAN HASSELT).

Pour quelques cas seulement de chondromatose unilatérale on connait le résultat de l'examen histologique des tumeurs. La constatation faite ici est à peu près semblable à celle qu'ont faits WEISS et BENTZON dans les cas qu'ils ont examinés.

L'examen microscopique de la chondromatose unilatérale n'a pas déterminé s'il fallait conclure à une maladie sui generis. Cependant il faudra bien, qu'on considère la ch: unil: comme une maladie propre, étant donné qu'il est nécessaire qu'il y ait une cause qui détermine la localisation unilatérale dans tous les cas, connus jusqu'ici.

Théoriquement on serait amené à considérer comme cause ou bien une perturbation qui se produit très tôt dans l'embryon, lors du développement mésodermal, ou bien un processus trophonévrotique.

L'asymétrie de la face expliquerait l'hypothèse BENTZON, qu'une perturbation du nerf sympathique serait la cause. D'autres symptomes pathologiques du nerf sympathique ne se sont pas manifestées dans notre cas. Et la partie gauche du corps étant moins développée que la partie droite, il me semble que l'on ne doit pas attacher une trop grande importance au développement restreint de la partie gauche de la face.

L'énumération des autres cas et de la littérature peut être laissés ici de côté; il suffit de se référer aux articles de BOJESEN dans »Fortsch. a. d. g. d. Röntgenstr.» Bd. 24 et de BENTZON dans cette revue (vol. III, fasc. 2—3).

RÉSUMÉ

Description d'un cas de chondromatose unilatérale chez une fillette de neuf ans. Toutes les tumeurs sont localisées au côté gauche; au côté droit, il n'y a que quelques petites places suspectes au pied. L'examen microscopique revèle que le tissu se compose de cellules de cartilage d'un type myxomateux. Le tissu conjonctif manque complètement. Au milieu de ces masses cartilagineuses se trouvent des cellules de moelle avec un vaisseau sanguin.

Des symptômes pathologiques du nerf sympathique ne se sont pas manifestés. Il existe bien une asymétrie de la face, mais la partie gauche du corps est moins développée et il faut donc ne pas attacher une trop grande importance au développement restreint de la partie gauche de la face.

SUMMARY

Report of a case of unilateral chondromatosis observed in a nine-year-old girl. All tumours are situated on the left side. On the right side are only a few small suspected patches to be seen. The pathological tissue is microscopically shown to consist of cartilaginous cellules of myxomatous type. Fibrous tissue is entirely lacking. In the middle of the cartilagenous masses cellules of bone marrow and bloodvessels are found.

Pathological symptoms of the sympathetic nerve are not manifested. The face is asymmetrical, but as the left side of the body is less developed than the right side this restrained development of the face must not be given too great importance.

ZUSAMMENFASSUNG

Beschreibung eines Falles von Chondromatosis unilateralis bei einem neunjährigen Mädchen. Alle Tumoren sind auf der linken Seite lokalisiert; auf der rechten Seite finden sich nur einige kleine verdächtige Stellen am Fuss.

Die mikroskopische Untersuchung ergibt, dass das Gewebe sich aus Knorpelzellen von einem myxomatösen Typ zusammensetzt. Bindegewebe fehlt vollständig. In der Mitte dieser knorpeligen Massen finden sich Markzellen mit einem Blutgefäss.

Pathologische Symptome seitens des Sympathikus haben sich nicht gezeigt. Es besteht wohl eine Asymmetrie des Gesichts aber die linke Körperseite ist weniger entwickelt und man kann deshalb dem Zurückbleiben der linken Gesichtsseite keine grosse Bedeutung beimessen.

AUS DEN RÖNTGENINSTITUT DES SERAPHIMERLAZARETTES
CHEF: PROFESSOR GÖSTA FORSSELL

PATELLA PARTITA

von

Hans Hellmer

(Tabula XXIII)

Während des zweiten Halbjahres 1923 hatte ich im Röntgeninstitut des Seraphimerlazarettes Gelegenheit drei Patienten zu untersuchen, welche eine Teilung der Kniescheibe in zwei oder drei Teile, mit andern Worten, die Anomalie aufwiesen, die in der Literatur unter dem Namen *Patella bipartita* und *tripartita* geht. Da diese Erscheinung in der schwedischen medizinischen Literatur bisher nicht beschrieben ist, und sie sowohl für den Chirurgen als für den Röntgenologen vom diagnostischen Standpunkt Interesse besitzt, will ich in Kürze über meine Fälle und über die Ansichten berichten, die bisher betreffs der Natur dieser Veränderung vorgebracht worden sind.

Fall I

25 jährige Frau. Gesund bis anfangs 1923. Damals im Laufe eines Monates wiederholte leichte Traumen gegen das *rechte Knie* (Skilaufen). Zweimal direkte Stösse gegen die Kniescheibe. Patientin hatte niemals Beschwerden, die sie zum Liegen zwangen. Nach ungefähr $^1/_2$ Jahr begann sie Schmerzen im rechten Knie zu bekommen, wenn sie es überanstrengte, wozu sie infolge ihres Berufes, der sie nötigte viele Treppen zu steigen, eine Zeitlang gezwungen war. Die Schmerzen kamen sowohl bei Beugung als bei Streckung des Knies. Allmählich nahmen die Beschwerden zu. Von einem Trauma des *linken Knies* ist der Patientin nichts bekannt. Am 4. X. 1923 wurde sie auf der hiesigen chirurgischen Poliklinik untersucht. Das *rechte Knie* wies damals nichts Abnormes auf.

Röntgenbefund: Linkes Knie (Fig. 1 und 2 auf Tabula XXIII)

Patella in normaler Lage. Sie besteht aus zwei Segmenten: einem distal-medialen, dessen Grösse wenig hinter der einer normalen Patella zurückbleibt, und einem proximal-lateralen, das auf dem mit ventro-dorsaler Strahlenrichtung aufgenommenen Radiogramm eine Grösse von 23 × 12 mm hat.

Die beiden Segmente sind voneinander durch eine ungefähr 3 mm breite Zone getrennt, welche in einem Bogen verläuft, dessen Konkavität nach der

proximal-lateralen Seite gerichtet ist. Die gegeneinander gewendeten Konturen der Segmente verlaufen im ganzen parallel und sind zweifellos scharf.

Durch diese Scheidung in zwei Teile, welche etwas voneinander abstehen, erhält die Patella in proximal-lateraler Richtung ein etwas grösseres Ausmass.

Am besten tritt die Veränderung auf Radiogrammen hervor, die derart aufgenommen sind, dass der Zentralstrahl von hinten-lateral nach vorne-medial geht, bei lateraler Verschiebung der Patella (Fig. 1). Auch auf Seitenbildern wird die Veränderung gut sichtbar (Fig. 2). Auf Bildern mit ventro-dorsaler Strahlenrichtung schimmert sie durch den Femurschatten durch.

Sonst weist die Kniegelenksgegend keine merklichen Veränderungen auf.

Rechtes Knie

Patella in drei Fragmente geschieden, von welchen die beiden kleineren dieselbe Lage haben, wie das kleinere Fragment der Patella sin., welches sie zusammengenommen an Grösse etwas übertreffen. Die Hauptrichtung der Zonen, welche die 3 Fragmente scheiden, ist ausgesprochen geradlinig. Die gegen einander schauenden Konturen sind im grossen ganzen parallel, aber unregelmässiger als auf der Patella sin.

Die rechte Kniegelenksgegend zeigt im übrigen keine nachweisbaren Veränderungen.

Fall II

50 jähriger Mann. Bekam 1921 einen Schlag mit einem Hammer gegen die mediale Seite des *linken Knies* und wäre beinahe gefallen, wobei sich das Bein irgendwie »einbog», in einer Weise, die Pat. nicht näher angeben kann. Nach einigen Stunden sperrte sich das Bein in gerader Stellung. Am folgenden Tag Schwellung. 5 Tage später wurde Pat. in das Seraphimerlazarett aufgenommen. *Linkes Knie:* Schwellung und Rötung. Ballottement der Patella. Empfindlichkeit bei Palpation über der Gelenksspalte. Beugung in ungefähr 80° Ausstreckung, wobei man ein deutliches Knacken im Gelenk hört. — *Röntgenbefund:* Nächst der oberen lateralen Kontur der *linken* Patella liegen ein erbsengrosses und ein bohnengrosses Gebilde, mit Andeutung von Knochenzeichnung und mit glatten Konturen, wahrscheinlich freie Gelenkskörper. Starke Spannung der Gelenkskapsel. Operation (29. IV.): »Auf der unteren Fläche des lateralen Femurkondyls zwei Defekte im Knorpel, ähnlich denen, die bei Osteochondritis dissecans entstehen. Der äussere Meniskus gerade davor, in derselben Sagittalebene wie diese Defekte, deutlich schalenförmig angeschwollen. Es ist wahrscheinlich, dass dieser Teil des ausserdem mehr als gewöhnlich beweglichen Meniskus bei manchen Gelenksbewegungen in die vordere von den obenerwähnten Gruben gelangt ist und dann nicht ohne eine gewisse Schwierigkeit aus derselben herausgleiten konnte, was Beschwerden verursachte. *Die auf dem Röntgenbild sichtbaren Körper am lateralen Rand der Patella waren bei der Operation deutlich zu fühlen, sie sassen aber unbeweglich fixiert an der Gelenkskapsel fest.* Exstirpation des grösseren vorderen Teiles vom lateralen Meniskus.»

Nach der Entlassung aus dem Krankenhaus immer noch Schmerzen im Knie.

Am 14. XII. 1923 wurde Pat. von der Reichsversicherungsanstalt behufs Röntgenuntersuchung des linken Kniegelenks in das Seraphimerlazarett geschickt. Er wies Anzeichen einer Synovitis auf, aber keine Druckempfindlichkeit der Patella.

Röntgenbefund: Linkes Knie (Fig. 3)

Die Patella zeigt eine Teilung in drei Fragmente, in ähnlicher Weise, wie es bei Fall I beschrieben ist. Femur- und Tibiagelenksflächen sind leicht abgeflacht. Auf dem Tuberculum intercondyloideum laterale, auf den Rändern der Tibiagelenksfläche und auf dem lateralen Rand der Femurgelenksfläche kleine zackenförmige Auflagerungen. Keine radiologischen Zeichen einer Knorpelzerstörung.

Rechtes Knie

Normale Verhältnisse.

Fall III

23 jähriger Mann. Trauma am *rechten Knie* im Oktober 1923. Später Schmerzen bei grösseren Anstrengungen. Am 18. XII. 1923 auf der chirurgischen Poliklinik untersucht. Wies damals »etwas Hydrops» im rechten Knie auf. Keine Druckempfindlichkeit der Patella.

Röntgenbefund: Linkes Knie

Patella zeigt eine Teilung in drei Fragmente, in derselben Weise, wie sie oben beschrieben ist. Auf Seitenbildern ist die Veränderung nur durch Unregelmässigkeit der Knochenzeichnung im oberen Teil des Knochens angedeutet (Fig. 4).

Sonst sind keine pathologischen Veränderungen im Kniegelenk sichtbar.

Rechtes Knie (Fig. 5 und 6)

Der laterale Teil der Patella, (der 11 mm im frontalen, 25 mm im vertikalen Durchmesser misst) ist von dem Rest des Knochens durch eine annähernd 2 mm breite Zone geschieden, die einen vertikalen Verlauf mit einer leicht lateral-konkaven Krümmung hat. Das frontale Ausmass der Patella ist nur wenig grösser als normal.

Die Veränderung ist auf Radiogrammen mit sagittaler Strahlenrichtung durch den Schatten des Femurs zu sehen (Fig. 5). Auf Schrägbildern tritt sie weniger hervor. Auf dem Seitenbild ist die Veränderung kaum sichtbar (Fig. 6).

Wir haben hier zwei Fälle von beiderseitiger Teilung der Patella in zwei oder drei Fragmente nebst einem Fall von einseitiger

Teilung in drei Fragmente. Vier von den untersuchten Kniescheiben weisen eine Teilung durch schiefgehende knochenfreie Zonen in zwei oder drei Teile auf, von welchen der kleinere (oder die kleineren) immer lateral-proximal liegen. Die fünfte Kniescheibe ist durch eine vertikale Zone in ein grösseres mediales und ein kleineres laterales Fragment geteilt. Im Falle III sehen wir beide Typen von Teilung vertreten.

Die *Diagnose* bietet, wenn man die Erscheinung einmal beobachtet hat, kaum irgendwelche Schwierigkeiten. Das Aussehen der Fragmente mit relativ glatten und vollständig scharfen Konturen ohne Zeichen einer posttraumatischen Reaktion, vor allem aber das Vorkommen der Teilung ohne vorausgegangenes Trauma erlaubt es von der Möglichkeit einer *Fraktur* abzusehen. Die häufig vorkommende Doppelseitigkeit ist hier eine grosse Hilfe. Die Kontrolluntersuchung der »gesunden Seite» besitzt deshalb in diesen Fällen, wie in so vielen anderen bei der Röntgendiagnostik von Skelettaffektionen eine grosse, oft ausschlaggebende Bedeutung. — In Fällen von einseitigem Vorkommen mit Verdacht auf Fraktur (wie z. B. im Falle II) muss man Lage, Form und Konturen der Fragmente beachten und das Bild mit den in der Literatur beschriebenen vergleichen. Die Teilung der Patella vollzieht sich nämlich in einer gewissen bestimmten Weise, so dass man die Röntgenbilder in vielen Fällen als pathognomonisch für die in Rede stehende Erscheinung bezeichnen kann.

Bei einem meiner Fälle (Nr. II) war von einem anderen Untersucher die Diagnose gestellt worden: »wahrscheinlich *freie Körper im Gelenke*». Diese Möglichkeit lässt sich mit Leichtigkeit ausschliessen, da an der Stelle, wo diese Fragmente liegen, *keine Gelenkshöhle existiert*, was aus einer Untersuchung im Frontal- und Seitenbild ohne weiteres hervorgeht.

Die grösste Schwierigkeit bei der Diagnose der Patellaraffektion liegt meiner Meinung nach in dem Umstand, dass sie auf Frontal- und Seitenbildern, d. h. auf Bildern, auf die sich die meisten Beurteilungen des Kniegelenks stützen, oft so wenig hervortritt. Auf dem Frontalbild wird der Schatten der Patella häufig ganz in den des Femurs projiziert und dieser Umstand sowie die geringe Dicke der Kniescheibe und der relativ grosse Abstand vom Radiogramm erschweren es beträchtlich, zu einem sicheren Urteil über diesen Knochen zu kommen. Dies gilt besonders von den nicht hinreichend »durchexponierten» Bildern. Dass die Teilung der Patella auf Seitenbildern schlecht wahrnehmbar sein kann, geht aus den Figuren 4 und 6 hervor, wo nur eine geringe Strukturveränderung andeutet, dass die Patella nicht normal ist.

Ob ein eventuelles *Übersehen* des Phänomens von Bedeutung für die Beurteilung des betreffenden Falles sein kann, will ich vorläufig dahingestellt sein lassen, um bei der Schilderung der vorgebrachten Ansichten über die Genese darauf zurückzukommen. Eine *unrichtige Diagnose* der einmal konstatierten Erscheinung ist von Bedeutung für die *Therapie* und für die *Beurteilung* des Falles vom Standpunkt der *Versicherung*[1] (vgl. Fall II).

Der Umstand, dass diese Affektion vom Untersucher leicht übersehen wird, hat wahrscheinlich eine gewisse Bedeutung für die Einschätzung ihrer Frequenz. Die meisten Verfasser haben ihre grosse Seltenheit hervogehoben.

Die bisher beschriebenen Fälle geteilter Patella lassen sich in drei Gruppen einreihen.

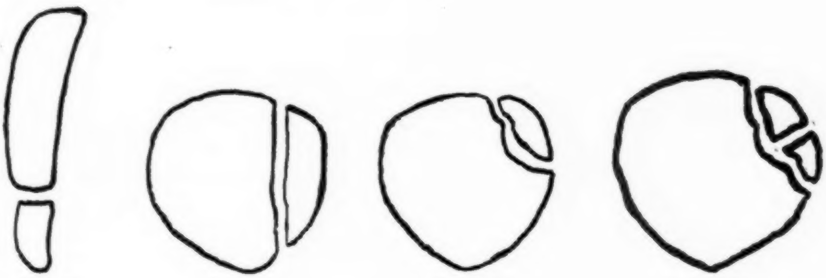


Fig. 7. Fig. 8. Fig. 9 a. Fig. 9 b.

Gruppe I. Die Patella ist der Quere nach geteilt (Fig. 7, Seitenbild). Das obere Fragment ist grösser als das untere. Die Patella weist eine beträchtliche Vergrösserung ihres vertikalen Durchmessers auf.

Gruppe II. Die Patella ist der Länge nach geteilt (Fig. 8). Das mediale Fragment ist grösser als das laterale.

Gruppe III. Die Patella ist durch schiefgehende knochenfreie Zonen in ein grösseres medial-distales und in ein (Fig. 9 a) oder zwei (Fig. 9 b) oder mehrere kleinere lateral-proximale Fragmente geteilt. — Gruppe II und Gruppe III haben gemeinsam, dass die veränderte Kniescheibe das Mass einer normalen wenig oder gar nicht überschreitet.

Der Anatom GRUBER ist der erste, der eine derartige Teilung der Patella beschrieben hat. Er schildert 1883 eine »In Bildungs-

[1] Während des Schreibens dieser Zeilen kommt mir ein Aufsatz im American Journal vom März 1925 zur Hand: »A congenital anomaly of the patella» von A. W. GEORGE und R. D. LEONARD, welche gerade »the economic importance in making a correct diagnosis in these cases» betonen.

anomalie mit Bildungshemmung begründete Bipartition beider Patellae eines jungen Subjectes». Beide Patellae waren hier so geteilt wie auf Fig. 9 a. Fig. 10 zeigt die rechte Kniescheibe. Über die Natur der knochenfreien Zone sagt GRUBER: »— — — die anfänglich rein knorpelige Verbindung durch Synchondrose wohl später eine ligamentöse — — — geworden ist». 1902 publizierte JOACHIMSTHAL das erste Röntgenbild der in Rede stehenden Erscheinung. Es zeigt eine doppelseitige Teilung, wie die auf Fig. 7. Gleichzeitig teilt er einen Präparatbefund von doppelseitigen Veränderungen wie auf Fig. 8 mit. Seither ist das Phänomen wiederholte Male beschrieben worden (WRIGHT, KÖHLER, ENDERLE, GRASHEY, REINBOLD, MOUCHET, HOLLAND, SAUPE, FLEISCHNER sowie GEORGE und LEONARD).

Fig. 10

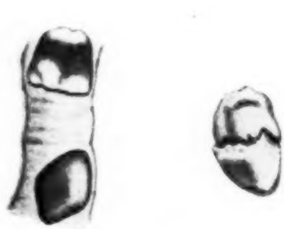


Fig. 11.

Seine Ansicht über die Ursache dieser Teilung drückte GRUBER schon im Titel der oben erwähnten Arbeit aus: »In *Bildungsanomalie mit Bildungshemmung* begründete Bipartition — —». Diese Auffassung wird von so gut wie sämtlichen Untersuchern solcher Fälle geteilt.

Nach BERNAYS tritt die Patellaranlage beim Fötus von 3 cm Länge als ein herzförmiges Knorpelstück auf der inneren Fläche der Quadrizepssehne auf. Im sechsten Lebensjahr beginnt die Patella zu verknöchern (JOACHIMSTHAL). Die Verknöcherung geht im allgemeinen von *einem* Kern aus. Es sind indes auch *mehrere* Knochenkerne oder »Knochenpunkte» beobachtet worden (PORTAL, RUDOLPHI, WEBER, RAMBAUD und RENAULT, SEIFFERT[1], MAYET[1]). In der *Ontogenese* können wir also Voraussetzungen für die Deutung des Phänomens als eine Bildungsanomalie finden.

Aber auch in der *Phylogenese* finden wir solche Voraussetzungen. BERNAYS hat bei mehreren Nagern einen Knorpelkörper auf der inneren Fläche der Quadrizepssehne unmittelbar proximal von der Pa-

[1] Zit. nach Mouchet.

tella und ungefähr von derselben Grösse wie diese beobachtet. Bei gewissen Raubtieren findet sich nach PFITZNER eine knöcherne Patella superior. Ich gebe hier (Fig. 11) nach diesem Verfasser eine Reproduktion der doppelseitigen Patella bipartita bei Viverra civetta (Zibethkatze).

Wenn in der knorpeligen Patella mehrere Verknöcherungszentren vorhanden sind, und die so entstandenen Knochenfragmente durch eine Bildungshemmung nicht verschmelzen sondern isoliert bleiben, bekommen wir eine Patella partita.

Die Anomalie, die in einer der Quere nach geteilten Patella besteht, wird mit Hinsicht darauf, dass die Grösse der beiden Fragmente zusammengenommen die einer normalen Patella weit überschreitet, auch als »Verdoppelung der Patella» bezeichnet. Im Gegensatz dazu werden die zu Gruppe II und III gehörigen Anomalien »Spaltbildung der Patella» oder Apophysenbildung genannt. — Als einen *beitragenden* Faktor für die Entstehung der ersteren führen JOACHIMSTHAL, SAUPE und FLEISCHNER die erhöhte Beanspruchung an, welcher die Festigkeit der in Entwicklung begriffenen Patella bei spastischen Zuständen der Oberschenkelmuskulatur, beispielsweise bei Littlescher Krankheit, ausgesetzt ist. SAUPE betont gleichzeitig, dass man ausserdem nach anderen Faktoren suchen muss, um die Erscheinung zu erklären, da ja die meisten Fälle von Littlescher Krankheit ohne Einwirkung auf die Patella verlaufen: »Dass eine Patella bipartita nur dann entstehen kann, wenn primär jederseits zwei Knochenkerne vorhanden sind, ist ohne weiteres klar.»

In prinzipiellem Gegensatz zu dieser allgemein gangbaren Ansicht steht die FLEISCHNERS: »— — — die angeführte Beobachtung der gelegentlichen Entwicklung der Kniescheibe aus zwei Knochenkernen nicht so sehr eine zweifache Kernanlage von Haus aus beweist, als vielmehr zu einer Reihe anderer Erscheinungen gehört.» Welcher Art diese Erscheinungen sind, das geht schon aus dem Titel hervor: »Gehört die Patella bipartita zum Kreis der *Osteochondropathia juvenilis?*» Diese Frage beantwortet der Verf. bejahend. Unter Osteochondropathia juvenilis versteht er u. a. KÖHLERS, PERTHES', SCHLATTERS und SINDING-LARSENS »Krankheiten». — Ohne auf eine Kritik der Tatsache eingehen zu wollen, dass der genannte Verfasser so verschiedene Erscheinungen wie die oben genannten unter eine Rubrik zusammenfasst, möchte ich nur auf die Knappheit des von ihm vorgelegten kasuistischen Beweismateriales hinweisen. Dieses besteht aus *einem* Fall von Patella bipartita sin. mit Morb. Schlatteri am anderen Knie bei einem 28 jährigen Mann. Dieses Material scheint mir allzu gering, um eine kategorische und definitive Lösung der Frage betreffs der Natur der Patella partita zu er-

lauben. Es ist auch nicht glücklich, die Patella partita mit diesen anderen pathologischen Zuständen zusammenzustellen, deren Natur im *wesentlichen* noch nicht klargestellt ist, und zu deren wenigen unstreitbar gemeinsamen Charakteristika eben die Dunkelheit ihrer Genese gehört.

Die in der Literatur beschriebenen Fälle von Patella partita sind häufig bei Röntgenuntersuchungen von Patienten mit posttraumatischen Kniegelenksbeschwerden zur Beobachtung gekommen (Vgl. die Fälle des Verf.!). Es besteht aber noch kein Anlass zur Annahme, dass ein Knie mit dieser Anomalie einen Locus minoris resistentiae darstellt. Ebensowenig hat sich ein Beweis für einen ursächlichen Zusammenhang mit der Arthritis deformans ergeben. Die publizierten Fälle von Patellaranomalie sind so gering an der Zahl, und die Klientel, die wegen traumatischer oder deformierender Kniegelenksaffektionen zur Röntgenuntersuchung kommt, so gross, dass wir in diesen Umständen eine völlig ausreichende Erklärung für das gemeinsame Auftreten haben. — Dass die Anomalie als solche den mit ihr Behafteten keinerlei Beschwerden verursacht, wird dadurch bewiesen, dass sie oft bei Kontrolluntersuchung des völlig symptomfreien Kniegelenkes angetroffen wird.

ZUSAMMENFASSUNG

Verfasser beschreibt drei Fälle von Patella partita, welche Erscheinung er als Bildungsanomalie vereint mit einer Hemmung der Verknöcherung betrachtet. Bericht über die bisher in der Literatur vorgebrachten Ansichten betreffs der Ursache der Teilung.

SUMMARY

The author describes three cases of Patella partita, a phenomenon which he considers to be a formative anomaly combined with a stopping of the ossification. He gives a summary about the theories regarding the cause of the anomaly hitherto expressed in print.

RÉSUMÉ

L'auteur décrit trois cas de Patella partita, phénomène qu'il considère comme une anomalie de formation jointe à un arrêt d'ossification. Il rend compte des théories émises jusqu'à ce jour dans la littérature médicale sur la cause de cette anomalie.

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AUS DER KLINIK DES ANATOMI VAN LEEUWENHOEKHUIS, AMSTERDAM
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ERFOLGE DER STRAHLENBEHANDLUNG DES HAUT-KREBSES

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In der Klinik des Niederländischen Krebsinstitutes (Antoni van Leeuwenhoekhuis) in Amsterdam, wurden seit der Errichtung im Jahre 1915 bis Ende 1921, 160 Fälle von Hautkrebs behandelt. (Hierzu sind nicht gerechnet 16 Fälle von Hautkrebs, welche auf lupösem Boden entstanden waren.) Wie dies auch in anderen Krebsinstituten der Fall war, wurden namentlich in den ersten Jahren fast nur sehr weit fortgeschrittene Fälle zur Behandlung überwiesen, bei denen alle anderen Methoden gescheitert waren, oder bei denen die Verbreitung und Tiefenwucherung so gross waren, dass kein einziger Chirurge sich zu einer Operation zu entschliessen wagte. (Völlige Inoperabilität.) Später, als man zur Einsicht kam, was mit der neuen Behandlungsweise zu erreichen war, wurde auch für viele, mehr beginnende Hautkarzinome, die Hilfe des Krebsinstitutes angerufen. Hierbei war auch ein grosser Faktor, dass nun auch beim Publikum die Vermeidlichkeit der Operation durchzudringen begann, was auch zur Folge hatte, dass die Patienten sich eher entschlossen und sich mehr im Anfangsstadium behandeln liessen. Die glänzenden kosmetischen Erfolge der Strahlenbehandlung waren natürlich gleichfalls ein wesentliches Propagandamittel.

Ebenso wie Andere erfuhren auch wir, dass der Hautkrebs hauptsächlich bei älteren Menschen vorkommt. Von unseren Patienten waren bei Antritt der Behandlung nur 15 jünger als 50 Jahr (ca. 9 %). Aelter als 70 Jahr waren 69 (ca. 43 %). Bei der Mehrzahl dieser Patienten bestand die Erkrankung schon seit vielen Jahren. Verhältnismässig selten wurde angegeben, dass der Krebs von einer zuvor an der selben Stelle anwesenden, gutartigen Neubildung ausgegangen sei (z. B. Warze, Naevus, Hämangiom). Auch kam es ziemlich selten vor, dass sich, in einer im langsamen stätigen Wachstum

begriffenen Geschwulst, eine plötzliche und rasche Entwicklung zeigte. In einigen dieser Fälle konnte die Wachstumsbeschleunigung mit einem Trauma in Zusammenhang gebracht werden. Auch müssen wir wohl annehmen, dass für das Entstehen der Geschwulst manchmal ein Trauma von kausaler Bedeutung gewesen ist. (Z. B. eine Schnittwunde will nicht heilen, an der offen bleibenden Stelle wird nach einigen Wochen oder Monaten eine Geschwulst angetroffen.)

Zwanglos konnten wir unsere Hautkarzinome in 3 Gruppen einteilen. Die erste umfasst die Geschwülste mit geringer Gewebeneubildung, wobei der geschwürige Zerfall im Vordergrund steht. Die alte Benennung »Ulcus rodens» ist also im Allgemeinen hierauf anwendbar. Bei mikroskopischer Untersuchung zeigten diese Geschwülste den Basalzellentypus.

Die zweite Gruppe umfasst die ursprünglich mehr exophytisch wachsenden Geschwülste, die, wenn sie in der Mitte zu Zerfall und Vereiterung kommen, doch fast immer einen erhöhten Rand beibehalten, welcher mit normalem, sei es auch mit dünnem, ausgereckten Epithel überzogen ist. Von dieser Gruppe wurde verhältnismässig eine grössere Zahl mikroskopisch untersucht. Im Gegensatz zu den Geschwülsten der ersten und dritten Gruppe, bleibt die Begrenzung gegen das umgebende, normale Gewebe, hier im Allgemeinen eine ziemlich scharfe, und findet die Verbreitung mehr durch Verdrängung als durch Infiltration statt. Es ist denn auch bei diesen Geschwülsten, dass man, wenn sie einmal durch Bestrahlung zum Verschwinden gebracht sind, die besten kosmetischen Resultate erreicht; und verloren geglaubte Gewebe oder Körperteile (Nase, Augenlider) wieder zum Vorschein kommen sieht. Als Regel sind es Basalzellenkarzinome, welche sich also verhalten. Nicht all zu selten sahen wir jedoch exophytisch wachsende Geschwülste, die aus verhornenden Pflasterepithel bestanden.

Als dritte Gruppe müssen wir die Geschwülste erwähnen, bei denen das Tiefenwachstum und der Gewebezerfall stark im Vordergrund treten. Anfressung des Knochens, der oft in grösseren oder kleineren Bezirken zutage kommt und abstirbt, ist keine Seltenheit. Vom klinischen Standpunkt gesehen, kennzeichnete sich diese Gruppe, die unserer Meinung nach nicht rein als ein weiter fortgeschrittenes Stadium der beiden andern aufzufassen ist, bereits im Anfang durch einen mehr bösartigen Karakter, sich äussernd, ausser durch beschwerlichere Beeinflussbarkeit, auch durch frühzeitigeres Entstehen von Metastasen.

Der grössere Teil war Pflasterepitheltypus.

Untenstehende Tabelle zeigt den mikroskopischen Bau in den drei verschiedenen Gruppen:

Tabelle I

	Gruppe I Flach	Gruppe II Exophytisch wachsend	Gruppe III Tiefenwuchs
Pflasterzellen	8	7	9
Basalzellen	22	12	5
Nicht untersucht	71	20	3
	101	39	17

In Bezug auf die Ausdehnung der Erkrankung, können wir noch bemerken, dass diese wohl hauptsächlich doch nicht regelmässig der Zeitdauer der Erkrankung entsprach.

Metastasen wurden 9 mal angetroffen, 4 mal beim Anfang der Behandlung, 15 mal entwickelten sie sich später. Ein Zusammenhang mit der Zeitdauer des Prozesses war auch hierbei nicht nach zu weisen. Der histologische Typus in diesen Fällen war: 3 mal Pflasterepithelkrebs, 1 mal Basalzellenkrebs, 1 mal carcinoma solidum. Vier mal hat keine mikroskopische Untersuchung stattgefunden.

Bei der kleinen Zahl von Fällen bei denen Metastasen gefunden worden sind, sagen diese Ziffern natürlich nicht viel, höchstens zeigen sie auf die grössere Malignität des Pflasterepithelkrebses, in dieser Hinsicht, hin.

Wir haben unsere Fälle weiter nach der Grösse eingeteilt, indem wir uns bemüht haben, die manchmal sehr unregelmässigen Formen schätzungsweise auf Zirkel von 1, 2, 3, und 4 cM. Durchmesser zurückzuführen, während die, welche eine noch grössere Fläche einnahmen, zu einer 5-ten Gruppe zusammengefügt wurden.

Wir bekamen auf diese Weise die folgende Einteilung. (Siehe Tabelle II.)

Tabelle II

	Flach oder mit Tiefenwuchs	Exophytisch wachsend	Total
1 cM.	54	15	69
2 cM.	20	12	32
3 cM.	15	5	20
4 cM.	7	2	9
grössere	22	5	27
	118	39	157

3 Fälle wurden uns nach einer Operation zur prophylaktischen Nachbestrahlung zugesandt. Es war hier nur eine Narbe zu sehen.

In 19 Fällen (ca. 12 %) bestanden ausser der Geschwulst, für welche der Kranke zur Behandlung kam, noch derartige Gebilde an anderen Stellen der Haut, von welchen einige noch als Praekarzinom

betrachtet werden konnten, während andere bereits ausgebildete Krebse waren.

Bei 2 Patienten traten nach kurzer Zeit Erscheinungen auf, die zur klinischen Diagnose c. c. oesophagi veranlassten; bei einem anderen Patienten entstand nach ca. 1/2 Jahr ein Harnblasenkrebs. Alle drei erlagen in kurzer Zeit diesen später aufgetretenen Geschwülsten.

Von unseren 160 Patienten waren 65 (ca. 40 %), bevor sie zu uns kamen, bereits anderswo behandelt worden. Diese Behandlung hatte bestanden aus einer oder mehreren Operationen, aus Röntgen-, Radium-, oder Mesothoriumbestrahlung, aus Kaustik. Auch waren öfters zwei oder drei dieser Behandlungsmethoden kombiniert angewandt worden. Welchen Einfluss dies alles auf den weiteren Verlauf hatte, werden wir später zu prüfen versuchen.

Behandlung

Diese bestand für die flacheren Ulcera bis zur Grösse von ca. 4 cM. Durchmesser gewöhnlich nur in einer Radium-Applikation. Dies geschah durch Radiumkapsel von 25 mm. Länge und 4 mm. Dicke, mit 11 mgr. Radiuminhalt, mit einer Wandstärke von 1/2 mm. Messing, zu einer anschliessenden Fläche zu vereinigen und zu umschliessen mit einer Hülse von Messing von 1/2 mm. Wandstärke und darum eine Lage Gummi, sodass also im Ganzen durch 1 mm. Messing filtriert wurde, und mit ungefähr 11 mgr. Radiumelement pro □ cM. bestrahlt wurde.

Dies wurde mit Heftpflaster auf der kranken Stelle befestigt. Der Ulcus und dessen Ränder mit der nächsten scheinbar gesunden Umgebung wurden auf diese Weise während 20 Stunden Bestrahlt. Nur bei einigen grösseren Krebsen und bei einigen Karzinomen der Augenlider wurde Röntgenbestrahlung angewandt. Manchmal musste jedoch wegen des nicht völligen Verschwindens der Geschwulst noch eine Bestrahlung mit Radium hinzugefügt werden.

Bei den exophytisch wachsenden Geschwülsten wurde als Regel die hervorragende Tumormasse mit dem scharfen Löffel abgekratzt, einesteils zwecks Entfernung der grössten Teile des Geschwulstgewebes, anderenteils um den Anschluss am Radium zu erleichtern.

Bei den Fällen mit grosser Flächenausdehnung liessen wir gewöhnlich bei den flachen, sowie bei den exophytisch wachsenden, eine Operation vorhergehen. Diese hatte nicht die Aufgabe, die Geschwulst bis ins Gesunde auszuschneiden, und suchte also nicht radikal zu sein. Man wollte nur erzielen, dass die grössten Massen der Geschwulst entfernt wurden, zusammen mit dem meisten, keiner

Heilung mehr fähigen Gewebe. Für die Vernichtung von Krebszellen, welche ausser diesem Gebiete liegen mochten, jedoch noch nicht zur völligen Zerstörung des präexistenten Gewebes geführt hatten, wurde also gänzlich auf die Bestrahlung gerechnet. Die auf diese Weise erhaltene grosse Wunde wurde später als Regel mit Röntgenstrahlen nachbehandelt. Nur wenn kleine Recidive auftraten, wurde auch das Radium zur Hilfe gerufen. Der histologische Bau war also nie ein Leitfaden für die Behandlungsweise.

Erfolge

Bei der Beurteilung der bei der Behandlung von Hautkrebs erzielten Resultate, müssen wir einen etwas anderen Masstab anlegen, als bei denen von anderen Karzinomen. Während im allgemeinen bei Krebse anderer Organe die Zahlen für die geheilten bei annähernder Berechnung gleich gestellt werden können mit denen der überlebenden Patienten, geht dies nicht an für das Karzinom der Haut, und würde hiermit ein gänzlich unrichtiger und viel zu ungünstiger Eindruck über die Heilungsmöglichkeiten gegeben werden. Das hohe Alter der Patienten mit einem Hautkarzinom hat ja zur Folge, dass sie, auch wenn ihre Geschwulst geheilt ist, oft nur verhältnismässig wenige Jahre die Behandlung überleben. Wir haben deshalb nebenbei nachgeforscht, wie viele der Patienten bis zu ihrem Tode ohne Recidiv ihres Karzinoms, und ohne regionäre Metastasen geblieben waren. Durch die leichte Beurteilung der erzielten Resultate konnten wir diesen Wegverfolgen. Das praktische Nichtvorkommen von Metastasen auf Entfernung gestattet uns in dieser Weise vorzugehen.

Bei der Bearbeitung unserer Krankengeschichten fiel uns allererst auf, dass in den meisten Fällen die Geschwülste bereits nach der ersten Radiumbestrahlung völlig verschwanden, doch dass es darunter auch mehrere gab, bei denen eine ein- oder mehrmals wiederholte Radium-Applikation nötig war. Um zu einer Uebersicht zu gelangen, haben wir unsere Fälle eingeteilt in die, bei welchen die Radiumbehandlung sofort gelang, und welche, wo dies nicht gleich der Fall war. Daneben forschten wir nach, in wieviel Fällen und bei welchen, nach anfänglicher, augenscheinlich völliger Heilung, ein Recidiv auftrat und welches das weitere Los dieser Patienten war.

Namentlich weil wir den Eindruck bekommen hatten, dass, gleich wie für andere Karzinome, das endgültige wohl-oder Nichtgelingen der Behandlung in hohem Masse abhängig war von der Verbreitung des Prozesses, machten wir eine Einteilung nach der Grösse. Diese

ist bereits früher erwähnt worden. Wir legten unsere Resultate in der folgenden Tabelle fest:

Tabelle III

	Zur Behandlung gekommen	Gestorben mit Geschwulst	Gest. ohne Geschw. Andere Ursache
1 cM	69	2	11
2 cM	32	4	4
3 cM	20	2	12
4 cM	9	7	—
grösser	27	12	2
	157	27	29

Beachten wir nun zuerst, was die Tabelle uns im Allgemeinen lehrt. Wir sehen dann, dass die kleinen Krebse (bis zu 1 cM. Durchmesser) von welchem histologischen Typus diese auch gewesen sein mögen, ausgenommen 2, alle geheilt sind. Die darauf folgenden zwei Gruppen, welche zusammen 52 Fälle zählen (bis zu 3 cM. gross) zeigen bereits ein weniger gutes Resultat (6 gestorben mit ungeheilter Geschwulst). Auch stellte sich heraus, dass in dieser Gruppe bei einer grösseren Anzahl Patienten die Behandlung im Anfang teilweise keinen Erfolg hatte.

Nicht sofort gelangen bei der ersten Gruppe 8 von den 67 geheilten Fällen, von den beiden folgenden Gruppen 15 von den 46. Bei den Karzinomen von 4 cM. Durchmesser oder grösser, zeigen sich die Resultate der Behandlung als sehr viel schlechter. Von den 36 Fällen ist nur bei 17 die Geschwulst dauernd geheilt, und nur bei beinahe der Hälfte von diesen gelang die Behandlung sofort.

Bei allen Gruppen zeigten sich öffers Recidive (25 mal auf 157 Fälle). Wir müssen erwähnen dass das Auftreten von Recidiven *nicht* insonderheit zusammentraf mit weniger glatt verlaufender anfänglicher Heilung.

Es ist jedenfalls merkwürdig, dass, ausgenommen einer, bei all diesen Patienten, bei denen sich ein Recidiv zeigte, dies später wieder durch Radium zum Verschwinden gebracht werden konnte, sodass nur ein Patient an oder mit nicht ausgeheiltem Krebs gestorben ist. Auch war die Heilung nicht auffallend schwieriger als bei den primären Fällen, und ebenso wenig nahm dadurch die Aussicht für das Entstehen erneuter Recidive zu. Zu unserer Ueberraschung sahen wir also dass die Prognose sich durch ein Recidiv nicht zu verschlechtern brauchte.

Ferner stellte sich noch heraus, dass verhältnismässig ungefähr

ebenso viele Recidive auftraten bei kleinen, anfangs geheilten, wie bei grossen, anfangs geheilten, Karzinomen.

Zum Schluss haben wir noch nachgeforscht, nach wie langer Zeit die Recidive bemerkt wurden. Aus untenstehende Tabelle geht dies hervor. (Siehe Tabelle IV.) Innerhalb eines Jahres zeigte es sich als eine Ausnahme, während es nach dem zweiten Jahr kaum mehr zu erwarten ist.

Tabelle IV

Recidive traten auf:

Innerhalb	1	Jahres	2
nach	1	Jahr	8
»	2	»	7
»	3	»	3
»	4	»	3
»	5	»	1
»	6	»	1
		Total	25

Nachforschung der Ursachen des Misslingens

Wir bemerkten bereits, dass 2 von den 69 Karzinomen von 1 cM. Durchmesser oder kleiner ihrem Krebs erlagen, oder immerhin starben mit einer ungeheilten Geschwulst. Wir haben uns nun bemüht die Ursachen des Misslingens der Behandlung ausfindig zu machen.

Der eine Fall betraf ein Karzinom in der Nähe des Gehörganges, das sich später darin fortgesetzt hatte, und dadurch nicht gut erreichbar ward für die Radiumbehandlung. Der andere war ein Krebs im inneren Augenwinkel, der nach seinem Verschwinden nach $2^1/_2$ Jahr recidivierte, und dann, trotz wiederholten Radiumapplikationen, wahrscheinlich gleichfalls infolge der Schwierigkeit des Gebietes nicht zu überwinden war.

Die Furcht vor Beschädigung des Auges durch die Radiumbestrahlungen war die Ursache, dass die Behandlung anfangs nicht kräftig genug eingesetzt worden war.

In beiden Fällen handelte es sich um Recidive von anderswo, bei denen bereits früher die Strahlenbehandlung angewandt worden war.

Es ist lange nicht unwahrscheinlich, dass dies zum ungünstigen Resultat beigetragen hat. (Über die Folgen vorhergehender Behandlungen, siehe später.)

Bei Gruppe 2 (bis ca. 4 cM. Oberfläche) sehen wir, dass sich bei zwei von den vier Fällen Drüsenmetastasen entwickelt hatten, die schon 2 oder 3 Monate nach dem Anfang der Behandlung bemerkt wurden. Diese haben sich nicht von der Röntgenbestrahlung beein-

flussen lassen und sind der Ausgangspunkt geworden für die weitere Ausbreitung.

Der 3te Fall betraf eine 72-jährige Frau mit einem Ulcus von 2 cM. Durchmesser, lateral vom Auge, der starkes Tiefenwachstum zeigte. Diese Frau war schon früher für dieselbe Erkrankung anderswo operiert worden. Trotz Excochleation, Radium und Röntgenbestrahlung verbreitete sich die Geschwulst und die Patientin starb nach 2 Jahren. Im 4ten Fall setzte die Geschwulst sich bereits vom Anfang an im Nasenloch fort und wucherte in diese Richtung weiter. Die beschwerliche Erreichbarkeit für die Radiumbehandlung und vielleicht auch Unterschätzung der Ausdehnung war hier wieder die Schuld des Misslingens.

Von Gruppe 3 (bis zu 3 cM. Durchmesser) sind 2 Patienten gestorben ohne geheilt zu sein. Eine starb unter Metastasierung und stätiger Verbreitung des Prozesses selbst; die Metastasen waren hier bereits beim Anfang der Behandlung vorhanden. Auch dieser Patient war bereits anderswo bestrahlt worden.

Die 2te Patientin war eine Frau von 85 Jahren mit einem Karzinom im medialen Augenwinkel auf den Augenball übergreifend. Sie starb bereits 5 Monate nach Antritt der Behandlung, ohne dass der Krebsprozess bezwungen war. Hier war es mehr die zu kurze Gelegenheit zur Behandlung.

Bei den Grösseren haben wir das Misslingen bei näherer Betrachtung zuschreiben müssen, entweder der Tatsache, dass diese Patienten ihrem Ende schon so nahe waren, dass sie nicht mehr genügend behandelt werden konnten (in 2 Fällen), oder der Entwicklung von Metastasen, die in 3 Fällen schon anwesend waren und in einem 4ten Fall sehr bald entstanden, oder auch einer derartigen Tiefenverbreitung, dass die Oberflächenbehandlung mit Radium eigentlich ungenügend war für das gehörige Treffen aller Krebszellen. In einem Fall war die Dura mater schon angefressen. Auch kann die ungünstige Beschaffenheit des Gebietes (Einwucherung in die Knochen) die beschwerliche Beeinflussbarkeit und in einigen Fällen dessen Misslingen erklären.

Ein Patient starb nach 2 Jahren und 4 Monaten ohne örtlich geheilt zu sein unter Erscheinungen, die eine Wirbelmetastase annehmen machten. Schliesslich hatten wir noch einen Fall, eine 36-jährige Frau betreffend, bei der die Diagnose auf Naevus-Karzinom gestellt werden musste. Bekanntlich sind diese von einer besonderen Malignität und es ist bis jetzt so zu sagen nie gelungen, mit welcher Behandlung es auch sei, einen derartigen Patienten zu retten. Wir haben den Eindruck bekommen, dass das Metastasieren, sowohl bei dieser Gruppe wie bei den weniger verbreiteten Karzinomen, auf einen

besonders bösartigen Verlauf hinweist oder als eine terminale Erscheinung aufgefasst werden muss, da keiner dieser Fälle geheilt werden konnte.

Alles zusammenfassend können wir feststellen, dass unter den 29 an oder mit ihrer Geschwulst gestorbenen 17 Recidivfälle wahren nach anderswo verrichteter Operation oder (und) Bestrahlung. Von den 12 übrigen mussten 8 schon beim Anfang unserer Behandlung als hoffnungslos betrachtet werden.

Zum Schluss wollen wir noch nachgehen, welcher der Einfluss ist, der das wohl oder nicht behandelt sein, auf die prognose ausübt

Es ergab sich, dass von den 160 Patienten 44 mit einem Recidiv nach anderwärts angewandter Behandlung zu uns gekommen sind. Von diesen 44 Patienten sind 27 (ca. 61 %) von uns geheilt worden und 17 an ihrer Geschwulst gestorben. Von den 116 Patienten, bei denen anderwärtig keine eingreifende Behandlung vorhergegangen war, sind 104 (ca. 89 %) geheilt worden. Nimmt man dabei an, dass von dieser letzten Gruppe, bei den 12 an ihrer Geschwulst gestorbenen, 8 vom Anfang an als verloren zu betrachten waren, dann sieht man, dass von 108 Patienten (operabele und inoperabele zusammen) 104 geheilt worden sind, also gut 96 %.

Aus dem Vorhergehenden ergiebt sich deutlich, dass die nach einer Operation oder Bestrahlung recidivierten Fälle eine viel schlechtere Prognose haben.

Zusammenfassend was wir aus dieser Abhandlung unserer Fälle von Hautkrebs gelernt haben, kommen wir zu den folgenden Ergebnissen

1. Jedes noch nicht behandelte Hautkarzinom, vorausgesetzt, dass es nicht durch besondere Umstände für Radium unerreichbar ist, und vorausgesetzt, dass noch keine Metastasierung stattgefunden hat, ist auf die beschriebene Weise dauernd zu heilen. In Berücksichtigung der nicht seltenen Operationsrecidive, auch bei kleinen Hautkrebsen, ist es als wahrscheinlich zu erachten, dass die Radiumbehandlung der operativen Behandlung überlegen ist.

2. Die 25 nach unserer Behandlung aufgetretenen Recidive konnten ausser einem einzigen alle wieder geheilt werden.

3. Von den von anderwärts zur Behandlung erhaltenen Recidivfällen (meistens nach einer Operation entstanden) konnten ca. 60 % geheilt werden.

Wo nun also hervorgeht, dass praktisch jeder Hautkrebs, wenn nur rechtzeitig behandelt, dauernd zu heilen ist, wird künftighin kein Kranker mehr daran zu sterben brauchen.

ZUSAMMENFASSUNG

Von 160 Fällen von Hautkrebs, behandelt von 1914 bis Ende 1922 (Beobachtungszeit 3—10 Jahre), sind die Endresultate der Strahlenbehandlung untersucht worden. Von Allen konnte der weitere Verlauf festgestellt werden, bei weitem die meisten der sich noch am Leben befindenden wurden von den Verfassern persönlich untersucht.

Die Mehrzahl der Patienten sind ausschliesslich mit Radium, die übrigen mit Excochleation und Radium — oder Röntgenbestrahlung, einige nur mit Röntgenstrahlen behandelt worden.

Im Beginn des Jahres 1925 waren noch 102 (63 3/4 %) am Leben, 28 waren inzwischen ohne Recidiv oder Metastasen gestorben, nach 1—8 Jahre nach der Behandlung, sodass wenn man rechnet, dass auch bei diesen die Behandlung gelungen ist, 130 (81 1/4 %) geheilt sind.

In 25 Fällen (15 1/2 %) traten nach 1—8 Jahre Recidive auf, die jedoch alle, ausgenommen einem, wieder mit Radium geheilt werden konnten. Bei 44 Patienten war schon anderswo eine eingreifende Behandlung vorhergegangen (eine oder mehrere Operationen, Bestrahlung oder Kaustik oder mehrere von diesen kombiniert). Von diesen konnten 27 (61 %) geheilt werden. Von den 116 vorher nicht anderswo behandelten wurden 104 (89 %) geheilt. Hiervon waren 8 von vornherein aussichtslos oder starben so kurze Zeit nach Antritt der Behandlung, dass die Beobachtungszeit zu kurz wurde.

Von 108 behandlungsfähigen neuen Fällen misslang die Behandlung in 4. Unterschätzung der Ausdehnung der Geschwulst, das Auftreten von Metastasen und ungenügende Erreichbarkeit für die Radium-Applikation war deren Ursache, wie auch bei den übrigen Fällen, wo die Behandlung scheiterte. In keinem einzigen Fall war es nötig später doch noch zu einer Operation über zu gehen.

SUMMARY.

The final results of 160 cases of skin cancer, treated by radiation during the period 1914- end 1922 (time of observation 3—10 years), are given. All the cases could be followed up, nearly all of the surviving patients were examined by the authors personally. Most of the patients received radium treatment only, a few of them X ray treatment only, the others radium or (and) X ray treatment after excochleation.

Jan. 1925 102 patients (63.75 %) were still alive and free from recurrences. Up till this moment, 1—8 years after the treatment 28 had died without local recurrence or metastases. Therefore, if we include these 28 cases, the treatment can be considered successful in 130 patients. (81.25 %.)

Recurrences during the first 1—8 years were seen in 25 patients (15.5 %), all of which with one exception could be cured by radium.

In 44 cases a previous attempt at radical cure by one or more operations, radiation treatment, caustics or some of these methods combined had failed, before the patients were seen by the authors. 27 cures could still be obtained amongst this group. Of the 116 cases not treated previously elsewhere, 104 (89 %) could be cured. 8 patients out of the 116 should be either considered as lost cases from the beginning or died so soon that results could

not be expected. In 4 out of the 108 other cases the treatment was a failure. Here as well as in the other insuccessful cases mentioned above, this was due to unexpected extension of the tumor or to the impossibility of sufficient radium application, or to the appearance of secondary growths. There was not a single case, where the authors were obliged to fall back upon surgical treatment.

RÉSUMÉ

Les résultats de la radio-therapie ont été contrôlés sur 160 cas de cancer de la peau, traités de 1914 jusqu'à la fin de 1922 (période d'observation 3 à 10 ans). Il a été possible de suivre le sort de tous les malades. La plupart de ceux qui vivent encore, ont été examinés par les auteurs de ce rapport eux-mêmes. La plupart des malades ont été traités exclusivement par le radium, les autres par curettage en combinaison avec le radium ou les rayons X, et d'autres encore seulement par les rayons X.

112 malades vivaient encore au début de 1925 (soit 63 $^{3}/_{4}$ %). 28 sont décédés sans récidive ni métastases dans un délai de 1 à 8 ans après le traitement; et si l'on considère que chez ces derniers le traitement a réussi aussi, 130 (81 $^{1}/_{4}$ %) malades ont été guéris définitivement. Dans 25 cas (15 $^{1}/_{2}$ %) des récidives survenues dans des délais de 1 et 8 ans ont toutes été guéries par un nouveau traitement au radium, une seule exceptée.

44 malades avaient déjà subi ailleurs un traitement sérieux (une) ou plusieurs opérations, radio-thérapie ou caustique ou une combinaison de ces traitements. 27 (61 %) de ces malades ont pu être guéris.

Des 116 qui n'avaient pas été traités d'avance ailleurs, 104 (89 %) ont guéri. Parmi ceux qui n'ont pas guéri il y avait 8 malades dont l'état était sans espoir dès le début et le décès étant survenu si peu de temps après le commencement du traitement, le temps d'observation a été trop court.

Sur 108 cas nouveaux et traitables il y en a 4, dont le traitement n'a pas réussi. Estimation insuffisante de l'étendue de la tumeur, l'apparition de métastases et l'insuffisante accessibilité de la tumeur pour l'application du radium en étaient les causes, aussi que dans les autres cas où le traitement n'a pas réussi. Dans aucun cas il n'était nécessaire de se déterminer plus tard à une intervention chirurgicale.

PROCEEDINGS OF THE DANISH RADIOLOGICAL ASSOCIATION 1922

Edited

by

Aage O. Wolff

Secretary

Seventh Meeting of the Association, Held at the Rigshospital on April 12, 1922

The editorial committee reported that Dr. REYN had been elected President of the association and Dr. PANNER, editor; the association electing Dr. FLEMMING MØLLER as collaborator in place of the latter.

The Chairman (Dr. REYN) presided, and opened the proceedings with some remarks in commemoration of the late Professor J. F. FISCHER; those present subscribing to his observations by rising to their feet.

Professor GAMMELTOFT was welcomed as the guest of the association.

O. WISSING: On treatment of malignant tumors with radium emanation (published elsewhere).

Eighth Meeting of the Association, Held at Rigshospital on May 10, 1922

P. FLEMMING MØLLER: *Demonstration of 2 Rare Cases of Gastric Tumors.*

A Röntgen picture was shown of the stomach of a 60 years old woman who had suffered from pain in cardia, oppression and vomiting for several years. There was achylia and slight retention 12 hours after Bourget-Faber's test meal. The picture showed a circumscribed irregular defect in the shadow in the pyloric area, and it seemed that the diagnosis cancer must be considered established. An operation showed that it was not possible to prove the presence of any tumor by external palpation of the stomach. A later section showed that it was a case of several pedunculated papillomata, one of which was as long and as thick as a finger, and projected into the pylorus. The case was demonstrated on account of the rareness of the affection, and in order to remind of the fact that variations in the Röntgen picture of the stomach, which might be interpreted as tumor defects, need not always signify the presence of malignant tumors.

Another picture of the stomach was demonstrated where it had not been possible from the Röntgenogram to establish the diagnosis tumor. It was surmised that a large left lobe of the liver pressed on the stomach. Nine months previously the patient had undergone Röntgen treatment for a round-cell sarcoma in the neck, originating from a nasopharyngeal tumor. Every trace of tumor in nasopharynx and neck disappeared in quite a short time. Six months later, vomiting and emaciation set in, and the patient died in constant emaciation and increasing cachexia. Post-mortem showed a round-cell sarcoma in the wall of the stomach, of the same character as in KUNDRAT's lymphosarcomatosis of the gastro-intestinal canal, and a quite similar sarcoma of the suprarenal gland. The speaker raised the question which of the tumors was the primary, a question which is very difficult to answer; but he thought that the large ulcerated tumor in the nasopharynx might in all probability be assumed to be the primary. Although metastasis of tumors to the intestinal canal is very rare, yet it cannot be precluded that there has been a primary KUNDRAT's lymphosarcomatosis of the stomach which, at first symptomless in itself, has caused metastasis to nasopharynx and the glands of the neck.

C. BAASTRUP: *New Arrangement for Adjustment and Filtration in Röntgen Treatment.*

Apart from Radiosilex and the American apparatus, somewhat uncomplicated boxes, in which the tube is fixed with transverse elastic bands, are in general therapeutic use in this country. Therefore it is rather a trouble to change tube, and there is a certain risk of jarring it when it is being fixed or removed. The area is limited by means of a diaphragm, or by circumscribing the desired field with lead-rubber. If it is desired to see wich area can be irradiated, this must be done with the aid of a piece of barium platinum cyanide, which is made luminous by holding it under the cone of rays in a dark place. A rather poor estimate of the area which can be irradiated is obtained in this manner which is unpractical, and precarious for the staff. At the congress in Copenhagen, in September 1921, FORSSELL demonstrated an apparatus which remedied the last mentioned difficulty. The apparatus consisted of an electric globe placed in a round diaphragm. In adjustments, where the distance between the patient and the anticathode has to be changed, the diaphragm must be adjusted according to an empirical scale.

I have endeavoured to remedy this difficulties in the following manner: As you all know, Professor FISCHER and I several years ago constructed[1] tube-boards of quite a simple form — to employ and inexpensive. They are placed once and for all on each tube in use, and are only removed when the tube is finished. The therapy tubes can be applied in the same manner. But this cannot be done without altering the tube box. One side of this must be made foldable to allow the tube being pushed in, the tube-board running on rails. In my opinion, a tube box constructed in this manner has various advantages over the box now employed. The box ought to be rather longer than the one in use at present, on account of the not inconsiderable rays which emerge at the neck of the cathode.

FORSSELL's method of illuminating the irradiated area is indeed rather complicated, and therefore I have tried to simplify his system in the following manner:

[1] See Acta Radiologica Vol. III. 1924.

On a tube-board, exactly like those which carry the therapy tubes, stands an ordinary mignon-lamp with screen. In relation to the hole in the board, the lamp stands in exactly the same place as the anticathode of the tube placed on the board. An electric storage battery for the mignon-lamp rests on the board where, also, a simple contact arrangement is fixed. Therefore, by replacing the therapy tube by the electric globe, exactly the same area as one wants to irradiate with the Röntgen tube can be illuminated, without there being any need of considering the distance from the body.

This method is cheaper than FORSSELL's (if one has tube boxes with rail system); there is no scope for miscalculation, as there is in FORSSELL's method, it is easier to work, and perhaps, also, quicker to employ. I must admit, however, that I have had no practice in the use of FORSSELL's method, which is known to me only from the demonstration made by the inventor at the congress of radiologists.

Another point which I have to mention to-night is a safe method of avoiding treatment with Röntgen rays without filter. Of course this system is of no interest where the same apparatus is used sometimes for treatment with filter and sometimes without, but in clinics where treatment is never, or scarcely ever, given without filter, but where sometimes aluminium and sometimes zinc for example, is used, this method will, I think, afford reliable security against treating without filter. One can employ:

1. The double-hook devised by me (see Acta Radiolog. Vol. III). One of the two conducting wires ends in a ring, and this can only be connected by a double-hook to the ring in the corresponding end of the Röntgen tube, and this hook is always connected to a filter.

2. Although we have used the double-hook for a number of years at Bispebjærg hospital, yet we have only once had a burn, due to the filter having shifted on account of its having been adjusted in a slanting position.

I, therefore, have constructed a lever which is fastened to each filter, and can be opened in a lock on the box. With this one is ensured against the shifting both of filter and diaphragm. At the end of the arm mentioned there is a plate which indicates the nature of the filter, which can thus be read at a distance. I think this plate is easier to read than the silk ribbons, of which the colour indicates the nature and thickness of the filter, and which are mentioned in the article in Acta Radiolog. refferred to above.

My best thanks are due to Messrs. LEVRING and LARSEN for the nice way in which they carried out my idea.

H. M. HANSEN: *On Emanation Tubes.* (Introduction to a demonstration of the production of emanation tubes in the physical laboratory of the Danish Radium Institute.)

As orientation before the production of emanation tubes is demonstrated, I shall mention some of the main features of the physical properties of radio-active matter. A radio-active substance is, as well known, a substance undergoing internal transformation; its atoms are spontaneously transformed into atoms of a new substance, and this transformation is accompanied by the emission of either an α or a β particle (α- or β-ray). The emission of β particles is accompanied by an emission of γ rays. As a rule, the new-formed substance is again radio-active, so that it is transformed into a third substance, and so on; in this manner the radio-active families or series are formed. Any

radio-active matter is most simply characterized by its half-period, i. e. the time taken for one-half of the substance present at a given moment to be transformed into the next substance. Radium is transformed into the gas radium emanation, and as the half-period of radium is very great (about 1600 years), a given quantity of radium does not decrease perceptibly for some time, and it can therefore be reckoned that a given quantity of radium is constantly producing emanation at the same rate. As the emanation itself is also radio-active, and therefore is further changed, the amount of emanation present in a radium preparation does not grow infinitely, but only into some equilibrium amount, which is reached when equal numbers of emanation atoms are formed and disintegrated each second. If the entire emanation contents of a radium preparation are removed (by heating or exhausting), and if the separated quantity of emanation is measured — by the aid of its radiation — this quantity will be found to decrease with a half-period of about 4 days (more exactly 3,85 days), so that after about 4, 8, 12, 16, etc. days respectively there is $^1/_2$, $^1/_4$, $^1/_8$, $^1/_{16}$, etc. respectively of the original quantity left. But in the radium from which its emanation contents have been removed, a new production of emanation takes place undisturbed, so that its emanation contents again will grow; this growth, however, takes place more and more slowly, as the new-formed emanation also is gradually transformed; after 4 days half of the original quantity is re-formed; after 8 days, $^3/_4$; after 12 days $^7/_8$; after 16 days $^{15}/_{16}$; and so on; after about 1 month, when the separated emanation has practically disappeared, the radium preparation has again practically its original emanation contents (the equilibrium amount), which then does not increase any further, an equal number of emanation atoms being again formed and disintegrated each second. The sum of the separated and of the new-formed emanation is always the same and equal to the original equilibrium amount, which is dependent only on (that is, proportional to) the quantity of radium itself.

A good idea of the process is obtained by comparing the transformation of a radio-active matter with the outflow of water from a tank. From the tank Ra, which must be imagined to be very high, the water flows out through the narrow pipe, for some time at a practically constant rate; this constant outflow corresponds to the transformation of radium at a constant rate into emanation, each drop of water that flows down into the tank Em signifying a radium atom which has become an emanation atom. The discharge-pipe of Em is much wider, corresponding to the far shorter half-period of the emanation. If, with the level shown, we imagine that the amount flowing out is equal to that flowing in, the water will not rise higher; Em's water contents correspond then to the amount of emanation which is present in the undisturbed radium preparation, the equilibrium amount. When, as mentioned above, we remove the emanation from the radium preparation, we must naturally, to carry on the analogy, pour this into a corresponding tank Em[1]. In the two tanks we can then follow the said decrease of the removed quantity of emanation and the reformation of the equilibrium quantity in the radium preparation.

However, the radiation from the radium itself and from its emanation (as well as from the first successor of this, radium A) is only alpha radiation, therefore of no essential medical interest. The medically important radiation, both the penetrating β as well as the γ radiation, is emitted from the two following successors, Ra-B and C, especially from radium C. As Ra- A,

B, and C all have a very short half-period, ranging from a few minutes to about half an hour, they will get into equilibrium with the amount of emanation in the course of 3 hours at most. When the said separation of the emanation from a radium preparation takes place, these substances will as a rule remain in the radium preparation, but as at first nothing new is formed they will have entirely disappeared in about 3 hours, and so the radium preparation will cease to emit the hard β and γ rays. On the other hand, the emanation will, 3 hours after the separation, again contain the entire equilibrium amount of Ra-A-C, and emit the normal quantity of hard rays. Therefore, apart from this delay of about 3 hours, which is insignificant as regards most practical purposes, one can reckon that the entire radiation from radium, which is of medical importance, is emitted from and accompanies the emanation. The following substances, radium D, etc. are very slightly active, or emit only soft rays of no essential medical importance, and so they need not be considered.

These facts are illustrated with the help of the tanks A, B, and C, which, corresponding to the very short half-periods of these substances, about 3, 27, and 19 minutes respectively, have wide discharge-pipes, and therefore contain only small equilibrium quantities. If we remove the water "emanation" from Em, then the tanks A, B, and C will very quickly run dry; this corresponds to the fact that radium, from which its emanation contents have been removed, is also after about 3 hours freed from the contents of Ra- A, B, and C. After this time, on the other hand, the tanks A', B', and C' will contain the equilibrium quantities, which then gradually decrease quite proportionately to the amount of emanation in Em'; and simultaneously the quantities in the tanks A, B, and C will gradually grow in proportion to the re-formed emanation in Em.

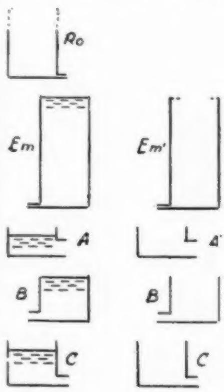

Fig. 1

For measuring quantities of radium the hard γ rays from Ra-C is employed, and emanation can therefore be measured in quite the same way as radium. The quantity of emanation, which is in equilibrium with 1 gram of radium element, is called 1 Curie emanation. It gives the same amount of hard radiation as 1 gram of radium, and for all medical purposes where only the hard rays are of any significance, it is therefore identical in effect with 1 gram of radium, but naturally its effect decreases with the half-period of the emanation. 1 Millicurie and 1 Microcurie are one thousandth and one millionth part of this.

For those who, when employing emanation, wish to indicate the dosage in conformity with French custom by the quantity of emanation disintegrated during the time of application, it will perhaps be of interest to know a convenient manner in which to find this quantity. On a suitably large scale one draws once and for all the curve of the transformation of an amount of emanation, as shown in the figure. The initial amount is arbitrarily fixed at 100. Next, one makes a "square" as shown in the figure, with the time marked out on the horizontal part above, extending towards the left, and the amount marked out on the vertical part on the right, extending downwards; both marked on the same scale as the curve. If one wishes to find

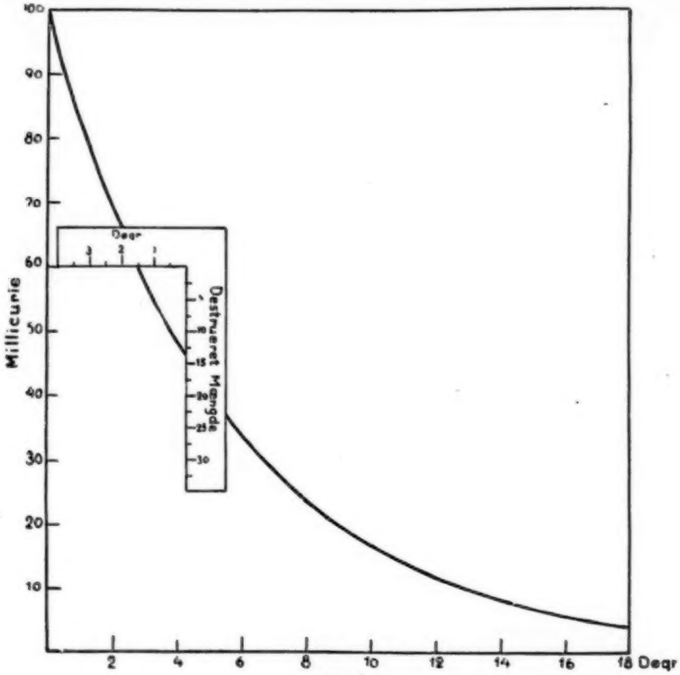

Fig. 2.

the amount disintegrated during the application of an emanation tube of an original strength of, for example, 60 millicuries, in, say 36 hours, one places the horizontal square at the point 60, so that 36 hours stands on the curve; on the right is now read the mass disintegrated during this period, about 13,5 millicuries in the figure.

The advantages of employing emanation instead of solid radium are first of all that every risk of losing radium is avoided and, next, that in each case one can distribute the amount employed in the most adequate manner, employ at pleasure one single strong tube or several less strong, and use surface applicators of any sort whatever, etc. On the other hand, we have as disadvantages in addition to the cost of producing the tubes the possibly somewhat smaller utilization of the quantity of radium at disposal. With appropriate employment, however, of used tubes which can be easily shortened without loss of emanation so that several can be placed in the same filter, or which can be used on surface applicators, one can no doubt reach a fully satisfactory degree of utilization.

The apparatus employed for the production of emanation tubes were gone into together with the demonstration of how a tube is made. A repetition will take too much space and will scarcely be of sufficient interest.

The solution of Ra Cl_2 (in diluted H Cl) is kept in glass retorts in a safe; from these a glass tube leads to a mercury pump. By the radium's effect on the water in the retorts electrolytic gas is constantly formed, so that by the pumping off the emanation becomes mixed with this gas, which facilitates both the pumping and the calculation as to how much has to be pumped off to get a tube of a certain strength. The gas holding emanation is brought into a so-called explosion pipet, where most of the detonating gas is removed by explosion; carbonic acid and moisture are removed by absorption in KOH. Afterwards the emanation, with a small remainder of gases, is brought into the cleaning apparatus, which at the top ends in the extremely narrow and thin glass tube into which the emanation has to be led. Close to this tube it is condensed in liquid air, and while condensed the remaining gas is pumped off. Then it is thawed and passed over mercury up into the narrow tube which is smelted off. Such a tube can easily be divided into several, and also shortened by condensing the emanation in the one end of the tube which is enveloped in a wad of asbestos moistened with liquid air, while the other end of the tube is smelted.

Further the measuring arrangement was demonstrated where the tubes, about 3 hours after their production, i. e. when the equilibrium amounts of Ra- C is formed, are compared with a radiumstandard of about 30 mg. The production itself of an emanation tube takes about 20 minutes at most; this short time stipulates that the production is relatively free from danger, as there is only time for a very small quantity of Ra- C to be formed, so that one is practically free from the hard γ rays during the production.

O. Wissing: *Radium Treatment of Cancer uteri ad modum* Regaud — (published elsewhere).

Discussion on this paper and the lecture at Meeting 7.

Chievitz warns us against believing too much in the importance of "striking the cells with the rays at the right moment of division". From what we know at present the cells take, in any case, several hours to perform what we have hitherto called a division. If we think of an old chronic *ulcus rodens cutis*, only very few cells showing stages of division will be found by microscopy, but it is certain, nevertheless, that in a certain number of cases we can cure this disease with one single Röntgen treatment of some hours duration, which again means that we have killed the cancer cells in spite of most of them not having been dividing at all.

It is possible that from the histological aspect of cancer forms we may draw conclusions as to the prognosis and treatment, but at present the material seems to me too uncertain in this respect.

Professor Gammeltoft: In connection to Dr. Wissing's interesting lecture, at which I have been very pleased to be present, thanks to the kindness of the Radiological Association, I wish to take the privilege of submitting a few remarks.

I am afraid, that Dr. Wissing's lecture gives unfortunately, a too optimistic view of the radium treatment, and especially so as regards its effects in cancer uteri.

When anyone has worked for a number of years with this method of treatment, as I have done, he must necessarily have experienced there will be many disappointments among the encouraging results obtained, disappoint-

ments which show not that the radium fails in its effect in cancer uteri, but that the technique still leaves much to be desired as regards the treatment. I will therefore caution against a too extreme optimism, and against the belief that the technique now recommended by REGAUD and his pupils is the last word in this matter. So far as I have understood, REGAUD has repeatedly altered his technique, and at rather short intervals too, and the method on which he has fixed his choice at present has only been tried for a relatively short time.

Dr. WISSING did not enter at all upon other methods, but we must remember that the results attained with the technique advanced by FORSSELL are still unsurpassed, and it is for REGAUD to prove that he can obtain still better results.

As regards details I will venture to say a few words as to the danger of infection; this is a factor which plays a large rôle, and it cannot be otherwise when we consider that it is a question of passing a RÖNTGEN tube up through an impure crater very rich in bacteria.

Every intrauterine interference increases greatly the danger of infection and I cannot understand therefore that this problem has not been further mentioned here to-night; one would think that this frequent placing and removing of the preparations mentioned by Dr. WISSING would greatly increase this danger.

Also, we endeavour to carry out the whole treatment within a reasonable time, but here we meet with the difficulty that a rise in temperature often occurs, after the application of the preparation and this compels us temporarily to postpone the treatment.

As regards the emanation treatment I am on all essential points in agreement with DR. WISSING; I think that enlightenment as to how large a ray quantity has been employed can be obtained in an easier manner than with the aid of the tables recommended by REGAUD. Mr JACOBSEN, the physicist of the radium station, has, together with Mr. H. M. HANSEN, worked out a graphic representation by the help of which it is extremely easy to read off how large ray quantities have been employed.

COLLIN: What surprises me most is the conception DR. WISSING has of the train of thought of the radiologists at the Pasteur Institute. He presents a series of problems in a manner as if they had been solved, and establish with emphasis a series of phrases which in my firm opinion are still much disputed by the people you quote. In my opinion he has expressed himself categorically just where in reality one is searching for a solution.

DR. WISSING's statement of the advantages of emanation over radium salt is not quite correct, thus, he mentions the long application as being best for the emanation; — on the contrary, it is the greatly concentrated, large doses of short duration which require emanation. In protracted treatment it is in itself immaterial what one uses; — he mentions the irradiation in one seance as being the only thing permissible. This I do not understand! At the Pasteur Institute to which he refers, very protracted treatment is employed, and there they are stout opposers of the stereotype maximum single dose. — He mentions the "triumphal progress of the radium puncture". It is too early, as even now, six months after his stay in Paris, radiopuncture has been abandoned in many cases, and these cases are now treated with "appareille de surface" or Röntgen-rays.

As regards the curettage of the uterus during the treatment (to remove necrotic tissue), this is no longer done; in any case I did not see it once (Feb.—March 22), on the contrary, the uterus was *flushed*. Something similar holds good of the intrauterine application of radium; one *attempts* this by applying the tubes right up to the fundus of the uterine cavity, but is by no means averse to perceive the disadvantage of this in order rather to concentrate the dose in the cervix.

Reyn: In the first place I wish to thank Dr. Wissing for his lecture. When he says that here in Denmark it is considered disparaging to give so large a dose that a tumor is cured by the first treatment, I do not think he is right. Most doctors, including ourselves, do certainly endeavour the first time to give such a strong irradiation as can possibly be given without damaging the sound tissue; but I think it is very seldom possible to cure a cancer (for example) by the first irradiation, and this must therefore often be repeated. If one continues to observe the patient, one will often find that there is something left which naturally has to be treated. Dr. Wissing will not irradiate until a recurrence occurs, but in reality this is the same thing, because a recurrence means only that there are still some parts of the tumor which have not been destroyed at the first irradiation. Dr. Wissing says, that Dr. Regaud demands that biopsy be made of every tumor before it is treated radiologically, to decide whether the tumor is radio sensitive, and that the risk of such a biopsy is as nothing when done in the correct manner.

As regards the first point I do not believe it is possible to establish by microscopy whether a tumor is radio-sensitive or not, as it would be necessary to treat a very long series of the various malignant tumors, to examine them microscopically, and to find afterwards which of them had disappeared and which had not. Such a long series as would here be required cannot possibly have been investigated as yet, because we must remember that radium treatment at the Pasteur Institute was only properly commenced after the war, and has therefore only been tried for quite a few years; in addition, I do not believe it is possible, taking it on the whole, microscopically to establish the prognosis, because the microscopical changes which so far have been made out with certainty are in reality very gross changes. If, for example, we take only cancer of the skin, two tumors are often met with which apparently are quite alike, but which are influenced quite differently by Röntgen rays, without it being possible to understand, let alone to explain, why this is so.

The second point, that such a biopsy does not involve any risk to the patient when, as in France, these biopsies are always made under the greatest aseptic and antiseptic precautions, and the tumor is first irradiated with a massive Röntgen dose which kills the uppermost layer of tumor cells, I do not believe to be correct either. As regards aseptics and antiseptics I believe that in this country the same precautions are taken as in France, and as regards the Röntgen irradiation, that great caution must be taken against trusting metastases not to occur by opening the blood and lymph tracts, even after one irradiation, because nobody knows whether the tumor cells are really killed, and if the tumor is not radio-sensitive, the certainty is hereby considerably depreciated.

Dr. Wissing says that Dr. Regaud is of opinion that all epitheliomata ought to be treated radiologically, and thinks that the basocellular are made

to disappear far easier by means of the irradiation than are the spinocellular. I do not agree with Dr. Wissing on these points. In my experience the prognosis for the baso- and spinocellular skin carcinomata, for example, is about the same. I think that many other circumstances play a part. If, for example, a carcinoma on the nostril has attacked the cartilage, it is very difficult, I think almost impossible, to make it heal by Röntgen irradiation. I think at present that on the whole it is wrong to say that all epitheliomata must be treated with rays, because in the first place there are certainly some which do not recover, and in the second place, operation performed in good time gives a remarkable, indeed, one may say a certain, prognosis if the operation is done in the right manner. And, besides, the radiological treatment is on the whole more troublesome for the patient. It is necessary to observe him to see whether the tumor disappears, and, if it does not, to irradiate him again. Should the patient stay away, he will occasionally turn up in such a condition that operation is impossible and radiological treatment fairly hopeless; because the patients frequently pay no heed to an epithelioma of the skin when it is not ulcerating. If, after the ray treatment, a small remainder of the carcinoma is left, this will perhaps go on growing without ulcerating, and may extend very considerably, without the patient taking any notice of it, till one fine day the affection ulcerates and the patient returns, as I have mentioned, in such a sad condition that treatment is out of the question. It is extremely difficult to decide whether a tumor has entirely disappeared following radiological treatment. In some cases I have treated skin epithelioma with Röntgen rays. The tumor has disappeared and it has not been possible to feel or to see the slightest trace. Afterwards I have excised the entire affected area, and on making serial sections, have found small foci of cancerous cells; there is always a possibility of a large outbreak occurring from these foci. If the patient stays away after an excision of a small skin carcinoma has been done correctly, the chance of recurrence is, on the other hand, very small. It is my belief therefore that in by far the greater number of cases one ought to excise. I have had a rather large experience, as in the course of years I have treated between four and five hundred cases[1].

As regards the microscopy it is correct that most skin carcinomata are basocellular (see footnote), but as soon as we leave the skin the conditions are reversed, as by far the preponderant number of cases are then of the spinocellular type.

There are still many things I should like to say, but I will no longer monopolize your time. There is, however, one thing I would like to mention. Dr. Wissing spoke a good deal about the alpha rays. These are no doubt of great importance in certain skin affections, and if they are not employed together with radium more than is now the case, this is due to practical reasons; they can, on the other hand, easily be used with chorium X, which we use in a considerable number of skin affections at the Finsen Institute.

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[1] Added later.

Up to the middle of 1921 I have treated 459 cases of skin carcinoma, not including cancer of the lip, at the Finsen Institute; 300 of these cases were microscopically examined, 252 were basocellular, 48 spinocellular.

WISSING: I thank the gentlemen who have taken part in the discussion.

To DR. CHIEVITZ I will say that when dealing with radio-sensitive tumors it is certainly somewhat immaterial whether one strikes the cells in a stage of division or not, while in more radio-resistant neoplasms it may perhaps be of greater importance to treat them in such a way that as many cells as possible are irradiated while they are dividing, and presumably one has the greatest chance of achieving this when the treatment is extended over some days, instead of being given as a massive single irradiation in the course of a few hours.

DR. CHIEVITZ attributed the expression "the right moment of division" to me, but I did not really say that. I know very well that a mitosis does not take place in a "moment", and in any case I do not understand what the meaning of the "*right*" moment of division would be in this connection.

Professor GAMMELTOFT was of opinion that from my lecture a too optimistic view of radium treatment of cancer uteri might be got. Meanwhile I was quoting Prof. REGAUD's opinion on this question, and to the best of my perception REGAUD takes an extremely sober view of the matter, and judges his results with every caution. He himself distinctly warns against believing that the last word has been said on the questions pertaining hereto, and he mentions the disappointments in different directions which the radium treatment has caused him like everybody else. Another thing is that undoubtedly, and *in spite of all*, there is reason for a certain optimism just where the radiological treatment of *cancer colli uteri* is concerned.

I purposely omitted to enter upon the methods of other radiologists because, in such case, the subject would be quite unreasonable for a couple of small lectures. Meanwhile I know, of course, Prof. FORSSELL's technique, and it is, no doubt, superfluous to mention that I have the greatest respect for his methods and excellent results, which were received with great interest at the Pasteur Hospital.

Professor GAMMELTOFT is no doubt right in saying that the daily application and removal of a radium applicator in the uterus greatly increases the danger of infection. I often thought of this when I saw the gynecologists at work in Paris, and several times I spoke of it to different doctors. They asserted, however, that the method had been used for about a year without special injuries resulting in consequence.

Dr. COLLIN wondered at my conception of the "train of thought" of the radiologists at the Pasteur Hospital, as in Dr. COLLIN's opinion I have expressed myself categorically on several questions which are still far from their solution. In reply to this I will only say that if Dr. COLLIN will *read* the radium treatises of later years by REGAUD and his collaborators he will there find stated exactly what I have said in my lectures. I don't mind admitting that in certain places I deliberately have expressed myself categorically, but in every single instance these remarks were a literal version of REGAUD's opinions as emphasized in his publications with italics, or as heard "established with emphasis" by him (to quote Dr. COLLIN) to the visiting doctors at the Pasteur Hospital. Naturally I do not mean, and I have never said, that in Paris they think they have reached finality in these difficult questions; but yet there are certain points of which something is known, certain technical conditions which have not changed essentially in

the last two years, and certain principles which are considered fairly established. Naturally one goes on experimenting steadily at the Pasteur Hospital as everywhere else in the world where scientific work is carried on, but these constant experiments happily lead to results in the course of time.

Dr. COLLIN said further that it was not "quite correct" that emanation was best adapted for long applications. No, but also in my lectures I have repeatedly asserted just the reverse, namely that REGAUD had more and more come round to the use of radium *salt* in long treatments, and as a reason for this I have stated that in this way a constant emanation mass and, consequently, a constant intensity were had during the whole irradiation, which is extremely important as regards the surrounding sound tissue. Consequently it is not "quite correct" on the other hand when Dr. COLLIN thinks that in protracted applications it is *immaterial* whether one uses salt or emanation!

Dr. COLLIN protested against my mention of the treatment in one serie as the only correct one in *curative* therapy in REGAUD's opinion, and supported his protest by saying that at the Pasteur Hospital it was just the stereotype, maximum, single dose they were opposed to. I do not understand what Dr. COLLIN means by this, for several times I emphasized in my lectures that REGAUD, especially wiht small radio-sensitive tumors gave a maximum dose but with relatively small intensity, *so that the treatment came to extend over 3—5 or even 10—14 days*, but that on the other hand, he demanded that the irradiation series should not be extended over more than the number of days mentioned.

By the "triumphal progress of the radium puncture" I meant that in many domains, and for obvious reasons, this form of treatment has supplanted the surface therapy, and this it quite incontestibly has done. But neither in this respect is the last word said, and it is possible that in certain cases the puncture must again give place to the surface application.

To Dr. REYN I would like to say that I have neither said nor meant that here in Denmark the administration of so large a dose of irradiation that there is a chance of curing a tumor at the first treatment is considered disparaging. On the contrary I have emphasized that REGAUD and his collaborators *do not repeat the irradiation before recurrence occurs*, while most Danish radiologists *on principle* give several (2—3) treatments, whether there is sign of recurrence or not. I believe that here also REGAUD's standpoint is the correct one, granted, naturally, that the patient is carefully observed, because if the tumor is destroyed at the first treatment there is no reason to give a further irradiation, the only result of which is the reducing of the vitality of the sound cells, and Dr. REYN is certainly not right when he says that it is only rarely that a malignant tumor is successfully cured completely by a single Röntgen or radium treatment.

Dr. REYN is at issue with Dr. REGAUD as to the risk of biopsy, and on the value of the biopsy as regards enlightenment as to the radio-sensitiveness of the tumor. I shall not be able to decide who is right in these questions, but can only repeat that at the Pasteur Hospital the histological examination is considered extremely valuable in the direction named, and that there it determines in many cases which treatment (radiological, surgical, or both) is to be given.

I have never seen the irritation dose mentioned by Dr. REYN employed

at the Pasteur Hospital, and it is not mentioned in the treatises by REGAUD and his staff which I have read.

Finally there is the question of the treatment of the skin epitheliomata. REGAUD is of opinion, as already mentioned, that the radiological treatment here gives the best prognosis, while Dr. REYN wants to excise these tumors in the great majority of cases. The fact is that both treatments give excellent results, and that the one can be just as good as the other. But why, all things considered, not combine them? If I myself had a skin epithelioma I would *first* treat it with Röntgen rays or radium and then, a few weeks later have it excised.

15 members present.

INTERNATIONAL CONGRESS OF RADIOLOGY

Preliminary Meeting—London—1st to 4th July, 1925

Central Hall, Westminster

Memorandum of arrangements

Date. The general arrangements remain as announced in a previous circular letter (January, 1925), meetings of Congress being arranged for 1st, 2nd, 3rd and 4th July, preceded by a reception at the house of the Royal Society of Medicine on the evening of Tuesday, 30th June.

The *Silvanus-Thompson Memorial Lecture* will be delivered by the *Duc de Broglie* (Paris), on the evening of 1st July; the subject (in Physics) to be announced later.

The *Mackenzie-Davidson Memorial Lecture* will be delivered by *Sir Berkeley Moynihan* (Leeds), on the evening of 3rd July; subject "The relationship of Radiology and Surgery".

An official dinner, for members and guests, including ladies, will be held on the evening of 2nd July.

Sections. The Congress will meet in three Sections. (1) Radiology; (2) Electrotherapy and Physiotherapy; and (3) Physics. All will meet in the Central Hall, Westminster.

Papers. Preference will be given to papers containing original work.

Papers read at any section should not occupy longer than 15 minutes; the extent of discussion following any paper will depend upon the time left for such discussion.

Typewritten or printed copies of papers submitted to be read at the Congress must be sent to the Secretary General, at the British Institute of Radiology, not later than May 1st, accompanied by a short abstract.

Abstracts should not exceed 500 words and should, wherever possible, be in English.

The abstracts of accepted papers will be printed and circulated at the Congress as far as possible, but this can only apply to papers received before the above-mentioned date.

Authors will be notified of acceptance or otherwise of their papers as soon as possible after their receipt.

Each paper read at the Congress will be in the language selected by the author.

It is intended to publish papers read at the Congress in the British Journal of Radiology.

Exhibition of Radiograms. A selection of negatives and prints will be exhibited in the British Institute of Radiology, including those relating to papers read at the Congress. Where lantern slides are employed to illustrate papers it is hoped that authors will also provide full size radiograms, either original or in reproduction, for this exhibition. Radiologists

are further invited to send radiograms (independent of papers) of general or special interest, either singly or in sets, for this exhibition, so that a representative collection may be secured of recent work as well as historic interest.

The executive of the British Institute of Radiology will be most grateful to members of the Congress who will present copies of negatives, prints or lantern slides to form the basis of a permanent international collection to be kept at the Institute.

Exhibition of Apparatus. An exhibition of radiological, electro-medical, physical and other apparatus, also of books and other objects of interest, will be held in the Central Hall, Westminster, during the four days of the Congress, and all the sections will meet in the same building. Firms wishing to exhibit should apply for particulars.

Membership. It is hoped that all who wish to attend the Congress will signify their intention as soon as possible so that some estimate may be made of the numbers attending.

The fee for Membership of the Congress is two guineas (£ 2. 2. 0).

Announcement of further details may be confined to members only.

Travel and Accommodation. Messrs. Thos. Cook & Son, have been appointed agents for the Congress and intending members are advised to get into communication with local representatives of that firm without delay. Hotel accommodation in London will probably be difficult to secure at a later date so that visitors are recommended to make early advance arrangements.

Trips. Our American colleagues have already arranged with Messrs. Cook & Son, for a rapid tour, including visits to Oxford, Manchester, and Cambridge, on July 6th and 7th, with extension to Glasgow and Edinburgh, and other members of the Congress, with limited time at their disposal, may wish to join in this tour. More leisurely visits to those and other centres will be arranged during the week following the Congress, details of which will be sent to members at a later date.

The Wessex branch of the British Institute of Radiology is arranging a day trip to Salisbury, Stonehenge and Winchester, which might be combined with an extension to the South Western Counties.

Independent trips or tours may be arranged with Messrs. Cook & Son, who will have a representative in attendance at the Congress.

Address. Correspondence and suggestions on any matter in connection with the Congress are cordially invited.

The house of the British Institute of Radiology will be used as the administrative centre for the Congress. An information Bureau with interpreters will be provided.

All communication should be addressed to:—

The Secretaries, International Congress of Radiology,
c/o The British Institute of Radiology,
32 Welbeck Street, London, W.1.

32, Welbeck Street, London, W.1.
March 1925.

Telephone: Mayfair 3273.
Telegraphic Address: Britology, Wesdo, London.
Cable Address: Britology, London.

NORDISK FÖRENINGS FÖR MEDICINSK RADIOLOGI

4:de möte

försiggår i Helsingfors den 1 och 2 september 1925

Inledningsföredrag:

1. **Röntgen- och Ljusbehandling vid kirurgisk tuberkulos.**
Inledare för Danmark, Chievitz: Den universelle Lysbehandling vid kirurgisk Tuberkulose, och
Reyn: Lyskilder til universel Lysbehandling.
Finland, Wetterstrand: Röntgenterapin vid kirurgisk tuberkulos.
Norge, Heyerdahl: Lysbehandling ved chirurgisk tuberculose, och
Amundsen: Röntgenbehandling ved chirurgisk tuberculose.
Sverige, Edling: Röntgenbehandling vid kirurgisk tuberkulos,
Malmström: Bidrag till kännedomen om ljusterapien vid kirurgisk tuberkulos.

2. **Om undervisning i medicinsk radiologi.**
Inledare: Forssell, Heyerdahl.
Diskussionsinlägg: Panner.

Inledningsföredragen skola vara inlämnade i tryckfärdig tillstånd till redaktionen av Acta radiologica senast d. 1 juni 1925.

Arbetsutskottet

Fig. 5.

Fig. 4.

Fig. 3.

Fig. 6.

Fig. 7.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

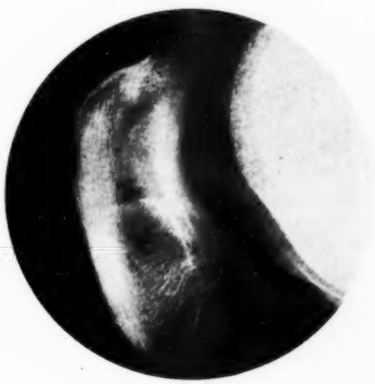

Fig. 6.